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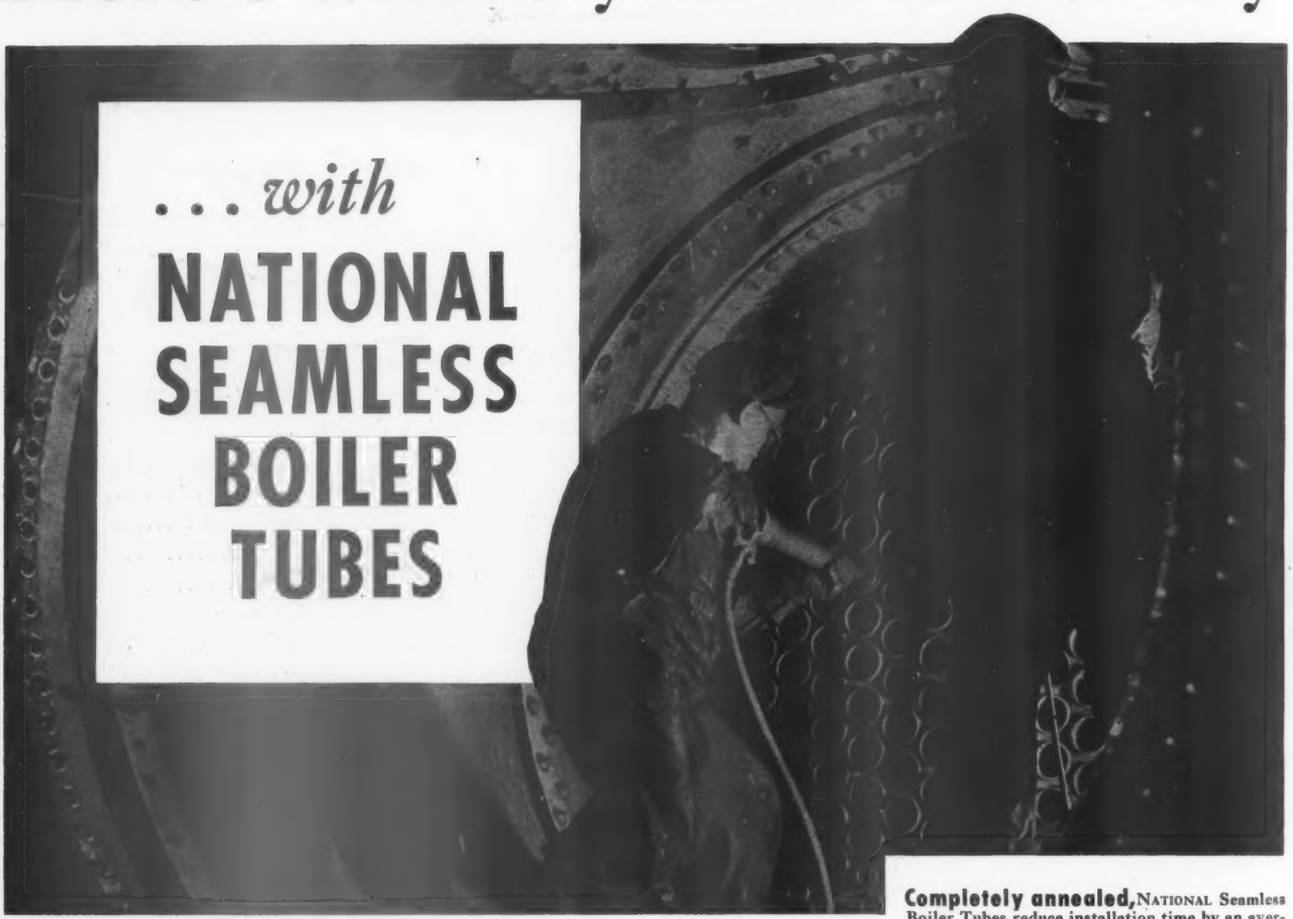
Here's where you Save Money



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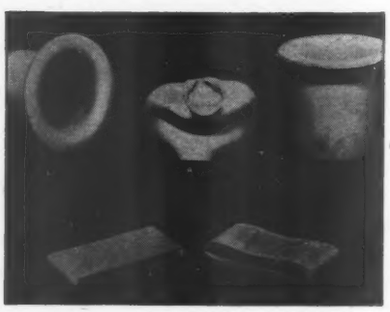

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UNITED STATES STEEL

Over 300 Attend

Mechanical Division Meeting

F. W. Hankins, Chairman

Program included reports on steam-locomotive development and Diesel locomotive operation — Study of freight-car trucks for higher speed service being pushed

W. H. Flynn, Vice-Chairman

V. R. Hawthorne
Secretary

W. I. Cantley
Mechanical Engineer

THE Mechanical Division of the Association of American Railroads held its seventeenth annual meeting at the Hotel Commodore, New York, on June 28, 29, and 30, with an attendance of over 300. Sessions were held during the morning of each day, with the afternoons free so that the members were afforded an opportunity to visit the transportation exhibits at the New York World's Fair.

During the meeting addresses were delivered by the division chairman, F. W. Hankins, chief of motive power, Pennsylvania, and by Samuel O. Dunn, chairman of the board of the Simmons-Boardman Publishing Corporation and editor of the Railway Age. W. J. Patterson, director, Bureau of Safety, Interstate Commerce Commission, and J. B. Brown, assistant chief, Bureau of Locomotive Inspection, Interstate Commerce Commission, also spoke briefly during the meeting.

Mr. Patterson raised a question as to the necessity of operating trains at speeds as high as 100 m. p. h. and said that, if such speeds are to be run, devices will have to be produced that will stop trains as efficiently in the 60- to 100-m. p. h. zone as they can now be stopped at speeds below 60 m. p. h. He drew attention to the fact that the hazard of high-speed operation has been increasing for several years and "we don't want it to continue if we can help it." In concluding his remarks, Mr. Patterson emphasized the necessity of providing better means of making emergency stops from within the train and of communicating with enginemen in emergencies. In this latter connection he mentioned the possible use of electrical communication equipment.

Mr. Brown, in the course of his remarks, directed attention to the fact that the Bureau is receiving constant complaints of hard-riding locomotives and asked that

attention be directed to this problem by members of the Mechanical Division. Chairman Hankins replied that this matter is now under consideration.

The program included 13 committee reports and an individual paper on the operation of Diesel-electric locomotives, by H. H. Urbach, mechanical assistant to executive vice-president, Chicago, Burlington & Quincy. In addition to those abstracted here, a report was presented by the Joint Committee on Utilization of Locomotives and Conservation of Fuel which presented statistical studies of locomotive and train operation during 1937 and 1938, compared with a selected list of preceding years. The General Committee also presented its formal report of events and actions since the last annual meeting which was held at Atlantic City, N. J., in June, 1937.

Election of Members of General Committee

Following the presentation of their names by the Nominating Committee the following were elected members of the General Committee to serve until June, 1941: H. B. Bowen, chief of motive power and rolling stock, Canadian Pacific; H. H. Urbach, mechanical assistant to executive vice-president, Chicago, Burlington & Quincy; G. McCormick, general superintendent motive power, Southern Pacific, and Otto Jabelman, vice-president, research, Union Pacific. G. C. Christie, general superintendent equipment, Illinois Central, was elected to serve for the unexpired term of F. R. Mays, general manager, Illinois Central, resigned, which expires in June, 1940.

Chairman Hankins' Address

Chairman Hankins, in opening the convention, reviewed recent developments in the mechanical department and important aspects of the work of the Mechanical Division. He stressed the following facts.

The two years that have just passed have been lean ones in so far as concerns railroad revenues. Nevertheless, we have witnessed very definite progress in the development and use of improved railroad equipment and in methods of operation. Even in face of discouraging business conditions the railroads have made distinct advance in motive power and rolling stock and in equipment maintenance practices.

The arch-bar truck, a very bothersome problem for a number of years, practically has been eliminated, and its use in interchange service is prohibited after December 31, 1939.

New and attractive types of passenger equipment cars have been built and placed in service, operating on faster schedules. New and improved freight equipment cars have been designed and built. Many thousands of existing freight cars have been modernized and rebuilt, and considerable progress has been made in the application of improved air brakes to freight equipment cars.

Present demands of our patrons have resulted in speeding up the schedules both of passenger and freight trains. This has introduced additional problems relating to design and maintenance of equipment, for example, the arranged freight-train service. The present faster schedules are only a forerunner of what is necessary in the quickening of deliveries in order to retain traffic on the rails. To insure reliability of this faster service, the cars must be maintained in such condition that failure of details will not occur en route.

All these problems that face us require not only special study, but also prompt solution, and involve our meeting the situation courageously and without unnecessary delay.

Since the last meeting of this division, the office of mechanical engineer has been created, and W. I. Cantley selected by the General Committee to fill it. He has been given a number of assignments and cooperates with all standing committees of the division. This has resulted in expediting consideration of important matters and will be developed further by the General Committee.

The purpose of the General Committee is not to build up a huge organization, but rather to have an efficient nucleus around which special machinery can be set up as required to handle important matters efficiently and with dispatch. The watch-word of your organization continues to be "Get things done."

At present we have before us the subject of development of trucks for high-speed freight service. The board of directors of the association has approved conducting road tests of trucks designed for this service. These road tests will be carried out to conclusion as early as practicable under direction of the mechanical engineer of the division and a special committee representing the Committee on Car Construction, the Committee on Brakes and Brake Equipment, and the Committee on Wheels.

A special committee has been appointed to survey the subject of counter-balancing of steam locomotives for high-speed service and to recommend whether or not tests should be conducted by the division.

Two years ago the General Committee recommended a research program on axles. This has been carried forward with expedition, starting with passenger-car axles, and to date three reports of progress have been submitted to the members so that they may be informed fully as to what is being accomplished. It is expected as a result of this research that modified design for passenger-car axles will be developed shortly.

The various standing and special committees of the division are entitled to credit and our thanks for the manner in which they have handled their assignments. With the reduction that has obtained generally in staff officers of the mechanical department—below what would have been considered a minimum several years ago—the members of your committees have discharged ably their duties in the work of the association, notwithstanding the additional work handled on the home road.

Among the outstanding achievements of the past year has been the development and adoption as recommended practice of specifications for new passenger-equipment cars. It was a fine example of prompt and efficient solution of a problem.

Address by Samuel O. Dunn

Samuel O. Dunn, editor Railway Age, was the guest speaker. An abstract of his talk follows: All the great technological progress made in this country within the last twenty years has done no good, because the contribution it should have made to the public welfare has been prevented by government, business and labor with the most ignorant, stupid, and ruinous economic policies ever suffered by a great nation.

A nation's total income is the measure of its well-being. It is usually stated in money, but it actually consists of the goods produced. The trends of our national income before and since the war present a shocking contrast.

We had recovered in 1896 from the panic of 1893. Allowing for differences in prices, and stated in volume of goods actually produced, our national income increased 82 per cent in the twenty years from 1896 to 1916—just before we entered the war—and our income per capita increased 30 per cent. During the next twenty years,

from 1916 to 1936, when undoubtedly there was equal technological progress, our national income (measured in production) increased only 17 per cent and our income per capita actually declined 8 per cent. In 1938 our income per capita was actually as small as thirty-three years before in 1905.

We have heard it claimed that unemployment, and even all the ills of depression, within the last decade have been caused by technological progress amounting to a revolution. There has been a revolution all right, but no more of a technological one than before, because the increase of production from 1896 to 1916 shows there was at least as much progress in technology then as since. The revolution we really have had since 1916, and especially since the war, has been an economic one.

Before the war we had both technological and economic progress. We have since had only technological progress. There is much talk implying they are the same thing; but they are widely different things. If a factory employing a hundred men increases its output 50 per cent per man by improving its machinery, that is technological progress. If it also increases its production and sales 50 per cent, that is economic progress. But if it does not increase its production and sales and consequently throws one-third of its employees out of work, there is economic retrogression. And that is actually the way in which, during the last two decades, we have simultaneously made technical progress and economic retrogression in this country.

You and other technical men have done your work splendidly. In spite of all the aspersions regarding lack of research and so on, engineering work of every kind has been as well done on the railroads as in any other American industry. It made it possible during the twenty years before the war for the railways to double the amount of traffic they handled per dollar of investment, per employee, per locomotive, and per car. The lack since the war of such economic progress as occurred before has been due entirely to unsound economic policies followed by business, political, and labor leaders.

Technical men have worked in accordance with physical laws. Business, political, and labor leaders have nullified all that technical men have done by trying to disregard or override economic laws. All human experience has shown it can't be done—and never so conclusively as in the United States during the last decade. Unsound economic policies have ruined many more great nations than war. Whenever they unearth the ruins of a great nation anywhere, you may depend on it that it was ruined more by its unsound economic policies than by its enemies; because sound economic policies are as necessary in war as sound military policies, while unsound economic policies are about equally ruinous in either peace or war.

Great Britain suffered vastly more from the great war than this country; but, as compared with the period before the war, Great Britain is now relatively much more prosperous than the United States. Why? Because during the depression Great Britain's business, its labor, and its government have followed the economic policies that pulled both Great Britain and the United States out of all previous industrial depressions, while we have followed entirely different policies. Hence, our economic revolution—backward.

Who started this economic revolution? Business—and it has since been ably assisted by politicians and labor leaders. Business started it when, before the war, in addition to railway regulation to stop unfair discriminations, it got regulation to curtail railway profits. Business continued it when it got our federal and state governments spending billions of dollars a year on waterways and highways to subsidize competition with the railways and thereby more effectively beat down their rates and profits. Our transportation situation, and especially our railway situation, has been among the principal causes of the depression and its long continuance.

We have had in this country what is called a system of "free private enterprise." In order to increase the national income as it did before the war, this system must operate in accordance with its own economic laws, the principal of which is supply and demand. From the depression of the nineties to the Great War most prices and wages were fairly flexible and were determined principally by supply and demand. But business began back there monkeying with prices (including railway rates) regardless of supply and demand.

These, in brief, are the causes of the economic revolution which has stopped our economic progress. They are the causes of the present railway situation because they have curtailed total production and traffic, diverted traffic from the railways to other carriers, and increased their operating expenses and taxes, with the result that their net earnings in 1938 were actually smaller than forty years before, in 1898.

Within the last week President Roosevelt has proposed, in addition to its present huge expenditures, that the federal government shall make about four billion dollars in "self-liquidating" loans to stimulate business, including a half billion dollars for buying equipment during the next three years to be leased or sold to the railroads. Their net earnings always have determined how much equipment and materials the railroads have bought, and I am unable to see how, without an increase in their net earnings, they could lease or buy any equipment from the government that they could not lease or buy direct from the manufacturers, while, if their net earnings did increase, they could and would increase their buying direct from manufacturers proportionately.

Their purchases of equipment and materials in 1938 alone were 972 million dollars less than in 1929, and in the last seven years they averaged 787 million dollars annually less than in the seven years ended with 1929. The proposed "government aid" would be mere chicken feed compared with the curtailment of railroad buying caused, and still being caused, by policies making net earnings less now than they were 40 years ago, and this entire new "self-liquidating" loan plan undoubtedly, in view of our experience with similar government policies for the last six years, would retard, rather than stimulate, business recovery and railroad earnings.

What shall we do about it all? First, no effort should be spared to continue technical progress in the railroad, as well as other industries, by the adoption of every improvement possible in equipment, materials and methods. Second, no reasonable effort should be spared to reduce present railway costs and, especially, labor costs. Present high labor costs are not due alone to present high wage scales, but are largely due to expensive working rules and to even more expensive interpretations and applications of them by certain bodies created by law. Third, we should spare no effort to get changes in present transportation policies of the federal and state governments which, contrary to the public interest, discriminate against the railways in favor of all other commercial carriers. Fourth, we have a broad duty as citizens; that is, to combat all the policies of government, business and labor by which we are trying to defy and override economic laws, the operation of which is essential to efficient functioning and preservation of a system of private enterprise.

Government, business, and labor, whether they know it or not or like it or not, must choose between free pri-

vate enterprise and state socialism. The longer they continue to socialize private enterprise, the more certainly they will cause state socialism.

Where do we go from here? That will depend upon whether we have enough men of intelligence, courage and patriotism to make enough efforts to get the American people to cause another economic revolution which will revive the great increases of production and commerce, and of railway traffic, earnings, and improvements that occurred before the war. It can be done. I believe it will be done, because I believe we have enough men of intelligence, courage, and patriotism to give the necessary leadership in the nation and in every state and community, and because I am sure the people are growing extremely tired of wallowing in the depths of this depression and will respond to the needed new leadership if it is offered them.

Report of Committee on Wheels

The committee, in its last report, commented upon the practice followed by some users of cast-iron wheels in connection with grinding the treads of the wheels either before or after mounting. In response to a questionnaire sent out by the secretary, soliciting information, replies were received from 27 railroads and private car lines, but in no instance was any definite information available. All replying to the inquiry seemed satisfied the grinding of the treads was a desirable practice, but as to the effect of such grinding, no definite information was available. The situation with respect to the value of ground wheels from the standpoint of reducing damage to lading was complicated where some information might have been available because snubbing devices have been applied to the trucks.

It is the opinion of your committee that the value of the use of truly round wheels will be reflected more in the reduction in truck maintenance than in a reduction in damage to lading.

Your committee is continuing its study of this subject and again solicits the roads following the practice of using ground wheels for any concrete information they may be able to develop with respect to the advantages obtained by this practice.

Single-Plate Bracketed Solid Hub Design Cast-Iron Wheel

The 1938 wheel committee report contained an account of authorization granted for certain types of experimental cast-iron wheels which included wheels with bracketed type plates and cored hubs. In this same report the committee expressed itself as being reluctant to accept the cored hub design without more intimate knowledge as to what might develop as a result of the cored hub.

In the meantime the Association of Manufacturers of Chilled Car Wheels developed and produced a bracketed single-plate wheel with a solid hub for 40,- 50- and 70-ton cars and requested authority to manufacture and place in service 100,000 wheels of each capacity, making a total of 300,000 wheels of this particular design. This request was approved by the General and Wheel Committees.

It is the opinion of your committee that the single-plate solid-hub, bracketed type wheel is a better design than the present standard single-plate wheel. This design has an advantage in that the plate is moved outward and thus better supports the outer portion of the rim and in this respect should be better protection against broken rims. Further, the bracketed feature on the back of the plate affords better support to the flange section and is claimed by the manufacturers to influence a more uniform chill.

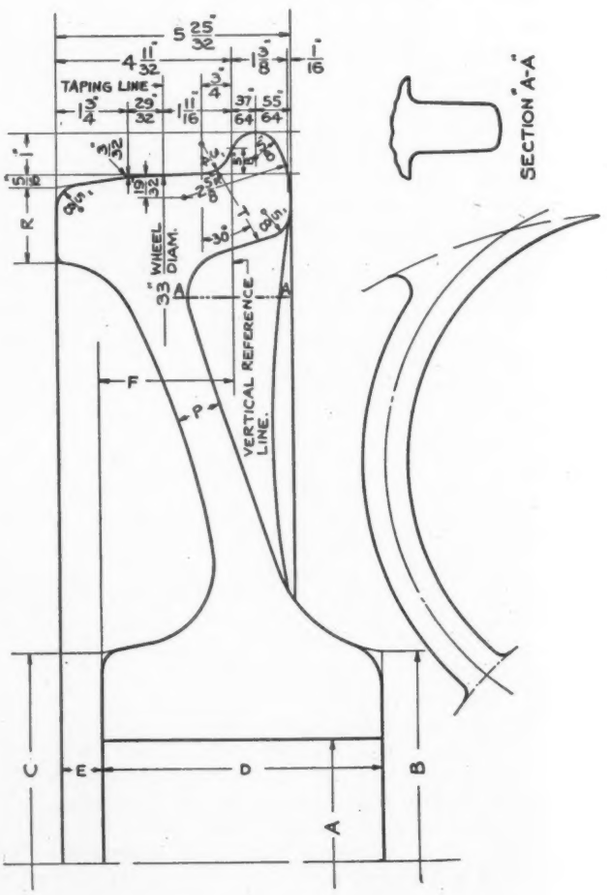
Your committee considers that the single-plate bracketed solid-hub type of wheel has sufficient advantages to warrant recognition over the present standard single-plate design and therefore recommends that the question of adopting this improved design of wheel to replace the present design of single-plate wheel be submitted to letter ballot of the members. This design of wheel is illustrated in Fig. 1.

The cast-iron wheel specifications have been tentatively revised, as shown in Appendix A, for study and consideration of the members during the coming year. (Appendix A is not shown in this abstract.)

Hub Clearance on Cast-Iron Wheels

A member road has reported that journal boxes, especially those on integral side frames, are contacting and being worn by the hub face of cast-iron wheels. This road requested that revision be made in the cast-iron wheel design to afford more clearance between the hub and journal box when journals, journal bearings, boxes, wedges, etc. are approaching the extreme limits of wear.

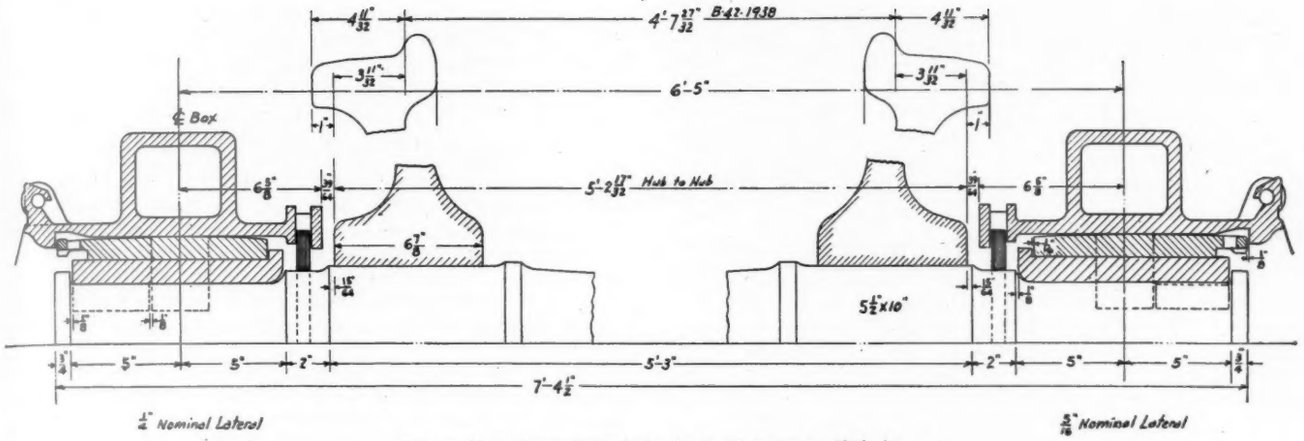
In a comparison of hub clearance as between the cast-iron wheel and wrought-steel wheel it will be noticed the cast-iron



Car Capacity	40-Ton	50-Ton	70-Ton
Nominal weight	700 lb.	750 lb.	825 lb.
Core size A	6 in.	6 1/2 in.	7 1/2 in.
Hub diameter, back B	10 1/4 in.	10 3/4 in.	11 1/2 in.
Hub diameter, front, C	10 1/4 in.	10 3/4 in.	11 1/2 in.
Length of hub, D	6 7/8 in.	6 7/8 in.	7 5/8 in.
Front hub recess, E	1 in.	1 in.	1 1/2 in.
Vert. ref. line to front hub, F	3 11/16 in.	3 11/16 in.	3 27/32 in.
Thickness of plate, P	1 in.	1 5/8 in.	1 11/16 in.
Thickness of rim, R	1 5/8 in.	1 5/8 in.	2 in.
Thickness thru throat, T	2 in.	2 1/8 in.	2 3/8 in.
Number of curved brackets	12	13	14

Fig. 1—The single-plate bracketed chilled-iron wheel

wheel has 1/16 in. more clearance with respect to the vertical reference line than the wrought-steel wheel, but if cast-iron wheels are mounted to the extreme spacing limits provided by the mounting and check gage with the gage contacting the wearing face of both flanges, this apparent additional hub clearance would be taken up in the mounting process. If, however, the wheels are mounted centrally on the axle and according to the recommended practice, with the mounting and check gage contacting the back of one flange and the wearing face of the opposite flange, the cast-iron wheel would have an advantage of 1/16 in. with respect to hub clearance.



6 in. x 11 in. journals back to back of boxes = 63¾ in.
6 in. x 11 in. journals hub to hub = 62 9/32 in.

Total hub clearance 1 15/32 in. or 47/64 in. at each wheel

Fig. 2—This shows the relative location of the several parts with nominal lateral. The wheels and journal boxes are centrally located

It is recognized that under certain conditions the journal box will contact the hub of the wheel, but there are so many contributing causes to this condition such as wheels not being mounted centrally on the axle, wheels mounted to the extreme spacing limits and general condition of the truck structure so that journal-bearing and box wear on one side are not supported by contact between the journal bearing and the axle collar on the opposite side, that revision of the wheel design does not seem the proper point of attack.

The present wheel design with offset arrangement of the hub and the rim which is accepted because of structural limitations does not represent a well balanced design and this condition should not be aggravated by any further increase in hub depression.

It is the opinion of the committee that if the conditions reported are existing to the extent that some definite corrective measures should be taken, a careful detailed study should be made of the truck structure, the spacing of wheels as to their effect upon the undesirable condition and then the subject referred to the Car Construction Committee if changes in design to correct the condition are deemed desirable.

Figs. 2 and 3 show the method followed by the Committee in making this study. These are presented as information and guidance to those who may, in the future, be making a further study from the standpoint of conditions other than wheel influence.

Removal of Cast-Iron Wheels for Worn Through Chill

Statements have been received from two individual car owners that they are having an unusual number of wheels removed from their cars on account of worn through chill and the thought has been advanced that this condition is due to placing the worn through chill defect back in the judgment class.

Your committee investigated 90 wheels removed from various cars for worn through chill condition, which wheels were inspected and subsequently broken to definitely develop the extent of the chill. Out of 31 wheels inspected at one point, 28 wheels were worn through chill, 13 of which did not take the out-of-round gage, 3 were not worn through chill and did not take the out-of-round gage, but did take the remount limit gage.

At the other point where 59 wheels were inspected and broken, 55 wheels in this group were actually worn through chill, but only 3 would have been condemned by the out-of-round gage. The 4 wheels not worn through chill each took the out-of-round gage and could have been condemned under Symbol 73-R.

Summarizing, of the 90 wheels removed for worn through chill, 83 were found in this condition which indicates the inspectors condemning these wheels were a little over 93 per cent correct in their judgment of worn through chill condition. This inspection also definitely established that the out-of-round gage could not be taken as a correct means of indicating the condition of worn through chill.

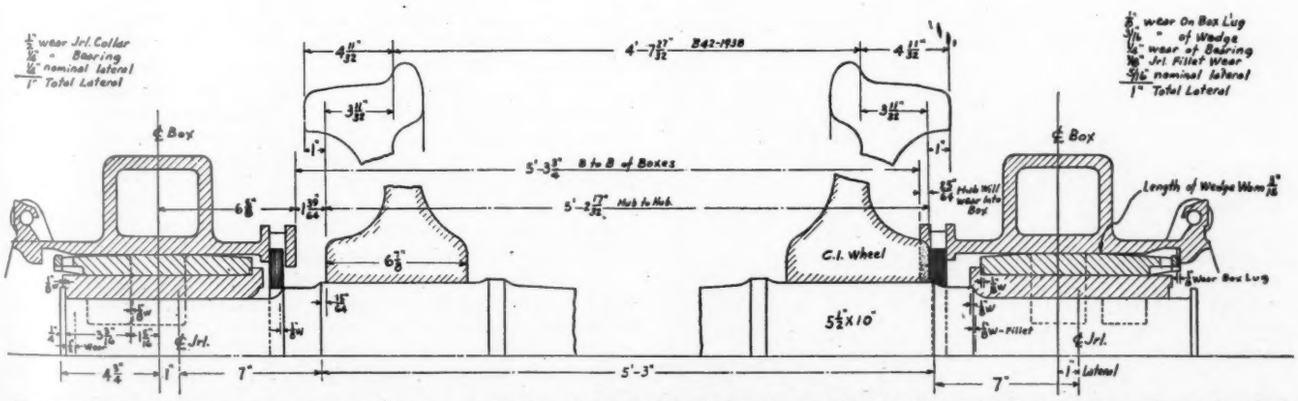


Fig. 3—Drawing showing wear of hub (cast iron wheel) into the journal box when the condemning limit of 3 3/16 in. between lug and end of bearing and ¼-in. journal collar is reached

Exhibit 1 of the 1937 report showed the roads reporting on the percentage of cast-iron wheels removed for different defects and that on Road *A* 19.47 per cent of the wheels were removed for worn through chill. Road *B* which is not a cast-iron wheel road showed only 3.72 per cent of the wheels removed for worn through chill, while Road *C* which is a cast-iron wheel road showed 27.08 per cent worn through chill. These figures were representative of conditions of wheels removed during the months of December, 1936, and January and February, 1937.

The committee is definitely of the opinion that the out-of-round gage is serving a good purpose from the standpoint of out-of-round condition but can not be recommended as a means of indicating worn through chill.

The committee has to date been unable to develop a definite gage for identifying the worn through chill defect and calls attention to the practice to be followed in identifying this defect shown in paragraph 102, page 117, of the Wheel and Axle Manual.

Measurement of Chill in Cast-Iron Wheels

The Association of Manufacturers of Chilled Car Wheels furnished information to the committee relative to its development of the new method of measuring chill in cast-iron wheels. Until recently this measurement was based on the judgment of the inspector from a visual examination of the fracture, which leads to wide variations in interpretation. The association set forth the steps leading up to the present method which is based on a definite relationship between the combined carbon and hardness as read either by Sceleroscope, Brinell, or Rockwell machines. Under the new method, wear requirements are satisfied with a hardness of 363 Brinell or 55 Sceleroscope taken 9/16 in. below the tread surface on the 3½-in. line. An upper limit is now being tentatively used which approximates the maximum passed under present methods of measurement in A. A. R. specifications. This calls for a Brinell hardness of 321 or a Sceleroscope hardness of 52 at a depth of ¾ in. below the tread surface. The association's statement concluded as follows:

"This method has gradually been introduced through our inspection department largely by careful education and detailed instructions on method of procedure and has now been effective for about twelve months, finally having been adopted by letter ballot of the members of the Association of Manufacturers of Chilled Car Wheels in connection with a general revision of specifications which are to be made effective June 1."

Multiple-Wear Wrought-Steel Wheels

Some service conditions to which wrought-carbon-steel wheels are subjected have developed within recent years which makes it necessary to give consideration to a heat-treated wheel in addition to those covered by A. A. R. Specification M-107. Service conditions have been imposing an increased burden upon wrought-steel wheels such as high wheel loads, high speed, braking requirements, as well as the design of the equipment and the condition of the track which it traverses.

Your committee has been collecting data relative to these special service requirements and the Technical Board of the Wrought Steel Wheel Industry has been diligently studying the problem and producing wheels of varying compositions and hardness characteristics that was felt were best adapted to the type of service to which they would be subjected. Sufficient data has been established to indicate that wheels representative of some type of heat treatment will be required to meet these various exacting service conditions and since there is no recognized practice prescribed for such wheels the committee, in conjunction with the Technical Board of the Wrought Steel Wheel Industry, are presenting for guidance a Tentative Specification for Heat-Treated Wrought-Carbon-Steel Wheels.

Of necessity this specification is of very general character and application, but it presents three different types of wheels classified as follows: Class A—High-speed service with severe braking conditions, but with moderate wheel loads; Class B—high-speed service with severe braking conditions and heavier wheel loads; Class C—service with high wheel loads and moderate braking conditions.

With this information available it will give the purchaser some basis upon which to make a selection. For instance, if trouble is being experienced with thermal cracking in high-speed service, and since thermal cracking is unquestionably connected with braking conditions, wheels according to Classes *A* or *B*, which have a comparatively low carbon content, would probably best meet this situation. Where trouble is being experienced on account of shelled treads which occurs frequently under locomotive tenders with heavy wheel loads, wheels corresponding to Grade *C*, which have a carbon range very similar to that of Specification M-107, but are heat treated to a minimum hardness of 321 Brinell will prove of value from the standpoint of resistance to shelled treads.

Suitable symbols stamped on the back face of the rim of each wheel identifies the class to which it belongs and provides against confusion in mating or identifying wheels for any particular service.

Removal of One-Wear Wrought-Steel Wheels for Built-Up Tread

It has been reported that owners of cars equipped with one-wear wrought steel wheels are suffering an unwarranted loss on account of wheels removed on foreign lines with built-up tread, the handling line contending that in accordance with Rule 98-(i), one-wear wrought steel wheels are not to be turned and consequently allowing the owning road only scrap credit for the removed wheel.

There is no reason why wheels removed for built-up tread should not be restored for further service by turning or grinding; grinding being preferable, as in the turning operation the cut would have to be taken below the work hardened surface of the tread at the expense of a greater loss of service metal. It is recommended that Rule 98, Par. (i), be modified as recommended below:

Proposed Form: Rule 98 (i)—The condemnable defects for wrought steel wheels in Rules 79 to 83 apply also to the one-wear wrought-steel wheel. Charges and credits shall not be on a service metal basis. Prices new, secondhand and scrap, as per Items 194-C and 194-D, Rule 101, shall be used.

Wheels removed account of having built-up metal on tread shall have this metal removed, preferably by grinding, or by turning where thickness of rim will permit. Note under Items 270, Rule 107, provides labor charge of 1.4 hours for grinding or turning.

The one-wear wrought steel wheel is identified by marking "1-W" on back of flange near wheel number or manufacturer's name.

Reason: To clarify the intent that one-wear wrought-steel wheels may be ground or turned to remove built-up metal on tread. See Par. 37 and Figs. 45 to 49, inclusive, in Wheel and Axle Manual.

Proposed Revision of Interchange Rule 69

In connection with the recommendations to adopt the single-plate, bracketed, solid hub wheel as recommended practice instead of the present single-plate wheel without brackets, some provision should be made for mounting on the same axles, wheels of the same nominal weight of the following designs: Experimental AARX single-plate wheel, present standard single-plate wheel, experimental AARX single-plate wheel with bracketed plate and solid hub, proposed recommended practice single-plate wheel with bracketed plate and solid hub.

In order to provide for such a procedure, suggestion is made that the fifth paragraph of Rule 69 be referred to the Arbitration Committee for revision substantially as follows:

Proposed Form: Cast-iron single-plate or single-plate bracketed solid-hub wheels varying in marked weight over 25 pounds must not be mounted on the same axle.

If the above change in Interchange Rule 69 is approved, the following revisions should be made in Interchange Rules 83 and 98:

Proposed Form—Rule 83 (1st par.): The application of double plate cast-iron wheels (regardless of date cast), of nominal weight less than 750 lb. to axles having journals 10 in. long or over, 700 lb. to axles having journals 9 in. long or over and 650 lb. to axles having journals 7 in. long or over; or cast-iron wheels without any weight cast thereon; or double plate cast-iron wheels cast prior to January 1, 1921; is prohibited.

Proposed Form—Rule 98, Sec. (c), Par. (5): Serviceable experimental cored hub wheels marked "A. A. R. X." when removed from service on account of defect in axle or mate wheel, shall be credited as scrap except when removed on account of Rule 32 condition in which event secondhand credit must be allowed for such undamaged wheel. Such wheels when subject to scrap credit shall be held and disposition requested from car owner. If car owner elects to have wheels returned, freight charges collect, shipping instructions must be furnished within thirty days from date of notification. No credit should be allowed for wheels so returned.

Interchange Rule 75

Considerable opposition has developed relative to interpretation given in last year's report regarding Rule 75. There was some contention that a change was made in Rule 75 without submitting the proposition to letter ballot. There were in fact no changes made in the rule. The Wheel Committee was asked for a definition as to what constituted a transverse crack extending into the throat of the flange. In an effort to define this reference more definitely, the committee suggested the interpretation note shown under Rule 75 and recommended a method of measurement.

It appears that some roads have used this interpretation to support the removing from service any wheels that show a slight checking in the throat of the flange and through this practice a hardship has been placed on roads whose wheels have been thus dealt with. To entirely remove the note without any further changes in Rule 75 leaves the reference to transverse cracks in the throat of the flange in the judgment defect class.

Cracks, regardless of their length, are considered as extending into the throat of the flange if they extend within 7/8 in. of the flange as measured with gage shown in Fig. 1, Interchange Rules, seems to be unduly restrictive. Under a strict interpretation of this rule, cast-iron wheels which show a fine checker network of thermal cracks in the tread would be condemned if this network comes within 7/8 in. of the flange. In this checker network, the cracks do not generally reach a length greater

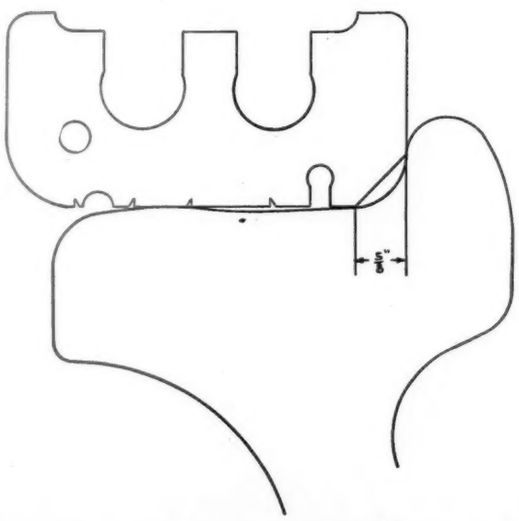


Fig. 1-A—Method of gaging brake burn transverse cracks extending into the throat of the flange of a cast iron wheel. See Rule 75

than 3/8 in., and inasmuch as they do not have any marked depth at this length, wheels with such cracks are safe to run.

The committee, therefore, recommends that the Arbitration Committee give consideration to revising the first paragraph of Rule 75 as suggested below and the note be eliminated.

Proposed Form: Brake burn, cracks: Cast-iron wheels with one or more transverse cracks in the flange or in the tread if over 2¾ in. in length, or if more than 1 in. in length and extending within 5/8 in. of flange as measured with gage shown in Fig. 1 and applied as shown in Fig. 1-A. See par. 107 and 108 and Figs. 83 and 85 in Wheel and Axle Manual.

If the foregoing recommendation is approved the third paragraph of Sec. (f)-3 of Passenger Car Rule 7 should be modified accordingly.

Proposed New Rule 75-A

Cast-iron wheels with a variety of tread defects, no one of which would condemn a wheel, are occasionally observed in service, the combination of defects being such that the wheel is not suitable for continued service.

Your committee has been requested to suggest a rule under which wheels unsuitable for service may be authoritatively removed because of such a combination of defects. In complying with this request it is recommended that the Arbitration Committee prepare a new Rule 75-A reading substantially as follows:

New Rule 75-A—Owner's Responsibility: Shelled out, flat spots, brake burn comby spots: Cast iron wheels having two or more defects not more than 3 in. apart and extending circumferentially on tread for a distance of 12 in. or more, as measured by the A. A. R. gage shown in Figure 76-A of the Wheel and Axle Manual, when such defects consist of any or all of the following: Shelled-out spots, one inch long or over but less than dimension shown in Rule 71; flat spots (except slid-flat spots), one in. long or over but less than dimension shown in Rule 71; brake burn comby spots, where metal has fallen out for a continuous circumferential length of ½ in. or over but less than dimension shown in Rule 75.

Removal of Wheels Loose on Axle

There has been brought to the attention of your committee a controversy developing between two roads, *A* and *B*, due to *A* removing from *B's* cars an unusual number of wheels account loose on axle. The position taken by *A* was there was indication these wheels were loose on account of oil seepage on the inside of the plate of the wheels.

No doubt every road at one time or other has been concerned about this proposition. In dismounting wheels showing oil seepage some will be found that are not loose on the axle, while the condition of other wheels fully justified their removal, and it is the opinion of the committee the roads can ill afford not to take every precaution against continuing in service wheels that may be loose on the axle even though an appreciably high percentage of wheels may prove secure when dismounted.

There is only one way to eliminate the removal of wheels on account of oil seepage and that is by better wheel-shop work through a higher degree of refinement in machining the axles, boring the wheels and in the fit tolerances observed. Improvement in these conditions, together with the use of the proper lubricant on the wheel and axle seats should insure wheel fits free from oil seepage.

Wheel-Shop Practices

The committee again wishes to emphasize the importance of wheel-shop work; that axles in their preparation have the wheel seat surface smooth machined and without taper, wheels be bored concentric with the tread and without taper and in the fitting of wheels and axles, the proper tolerances be observed to develop the desired mounting pressures when the A. A. R. recommended lubricant is used on the wheel seats.

In a recent investigation of wheel-shop practices covering inspection in 61 shops, only 44 per cent were rated as carrying on the work in conformity with standards prescribed in the Wheel and Axle Manual. The remaining 56 per cent were wholly or partially out of line with the practices recommended.

It is the opinion of your committee that if the Wheel and Axle Manual is put in the hands of all wheel-shop operators and sufficient support with regard to following the practices outlined is given by the higher mechanical officers, conditions such as observed in this inspection will be materially improved to the marked benefit of the operating road.

[The report included Appendix A giving tentative specifications for cast iron wheels and Appendix B for heat-treated multiple wear wrought carbon steel wheels. It also included the following notes on permissible wheel loads for wrought steel wheels, submitted by the Technical Board of the Wrought Steel Wheel Industries.—Editor]

Permissible Wheel Loads for Wrought Steel Wheels

The following notes are offered as a guide to the use of the various classes of wheels' covered by the tentative specifications for heat treated wrought steel wheels, and by the standard A. A. R. specifications M-107. A general summary is presented first, and this is followed by more detailed consideration of the main factors which affect wheel performance. Many of these factors cannot be covered by exact specifications, and it is therefore not possible to give hard and fast rules for the service to which the various classes of wheels should be assigned. It is hoped that the suggestions offered may be useful. As experience accumulates with the newer types of wheels, the situation can be clarified.

Until comparatively recent times standard operating conditions for which wheels to specifications M-107 were developed,

were represented approximately by maximum speeds of not over 70 m.p.h., and a service braking ratio of 90 per cent. Under such conditions satisfactory results can generally be obtained with untreated wheels to Specifications M-107, provided that the static wheel load does not exceed 600 to 650 lb. per in. of wheel diameter. Heavier wheel loads have been carried in tender service by heat-treated wheels with chemical composition in accordance with Specifications M-107. These are Class C wheels of the tentative specifications of October 6, 1938. Experience has shown that with these wheels difficulty may be expected with wheel loads in excess of 800 lb. per in. of wheel diameter with fully loaded tenders, and that loads of 850 lb. per in. or over represent wrong design.

In addition to the Class C heat-treated wheels of the composition covered by Specifications M-107, the tentative specifications offer two other classes, A and B, covering heat treated wheels with modified carbon content. These classes have been developed to minimize difficulties encountered in modern trains with high speeds and rapid deceleration. The large amount of heat generated on wheel treads by brake-shoe friction under high-speed conditions has caused undue thermal cracking. The modification of the carbon content has been made to provide greater resistance to thermal cracking of wheel treads.

It is not practicable to evaluate exactly the factors which determine the service for which these wheels are adapted. It is believed that Class A will have greater resistance to thermal cracking, but is intended for lower wheel loads. Class B is suggested for somewhat higher wheel loads with severe conditions of speed and deceleration.

It is to be understood that for both Class A and Class B wheels used with speeds much over 70 miles an hour, the wheel load per in. of diameter should be less than is allowed for wheels in moderate speed service and should be progressively reduced as the speed is increased. Exact relations between load and speed cannot be set up in the present state of knowledge. Further experience with wheels of these tentative compositions should clarify the situation.

Following this general summary of the uses of the wheels covered by the Tentative Specifications, the factors which affect wheel performance are considered in greater detail. Five important factors are: static wheel load, maximum train speed, braking requirements, conditions of track and design and condition of equipment.

Static Wheel Load

The static wheel load carried by the wheel in contact with the rail sets up compressive stresses in the tread of the wheel. Under normal conditions the area of contact between wheel and rail is small, and the compressive stress is high. The smaller the wheel diameter the smaller the area of contact for a given wheel load, and the greater the stress. Shelling is due to the break-down of the structure of the tread under repeated excessive compressive stresses.

Speed

Speed has a doubly injurious effect on wheel life.

(a) An increase in speed increases the impact force with which the wheel strikes rail ends, cross-overs, switches, and other irregularities in the rails. The impact forces add to the stresses due to static loading and increase the tendency to failure by shelling.

(b) An increase in speed increases the kinetic energy in the train. When brakes are applied this kinetic energy is transformed to heat by the friction of the brake shoe on the tread of the wheel. Overheating of the tread by braking from higher speed leads to the development of thermal cracks.

Braking

During braking, heat is generated by friction at the surface of the wheel tread in contact with the brake shoe. The rate at which this heat is developed is directly proportional to the wheel load, to the speed, and to the rate of deceleration. At high speeds even with normal deceleration the heat develops on the surface of the tread more rapidly than it can flow into the rim, and the tread metal rises to temperatures of 1,400 deg. F. and over. On emerging from beneath the brake shoe the tread metal is cooled rapidly by the flow of heat into the rim. This alternate rapid heating and cooling of the tread metal while the body of the rim remains at a moderate temperature, leads to the development of thermal cracks in the tread metal. It may also set up local stresses by producing quenched spots on the tread.

The rate at which heat is developed at the surface of contact between wheel tread and brake shoe is directly proportional to the speed, to the rate of deceleration, and to the load carried by the wheel. It, therefore, follows that if the rate of heat development is to be kept to a reasonable figure the wheel load must be kept down if speed and deceleration are to be increased.

It should be noted that as train speeds are increased it is natural to increase the rate of deceleration so as to avoid an undue increase in the distance required for stopping. Thus increase in train speeds frequently provides a double reason for using only moderate wheel loads. The rate of deceleration is directly proportional to the coefficient of friction between brake shoe and wheel and to the brake pressure ratio, which is the quotient obtained by dividing total brake shoe pressure on wheel by wheel load. As the coefficient of friction is beyond control an increase in rate of deceleration is obtained by increasing the brake pressure ratio. The increase in rate of deceleration thus produced increases, as has been seen, the rate at which heat is produced at the wheel tread.

Condition of Track

With track in poor condition the impact of wheels against irregularities in the rail may be greater than impacts at the same speed on better track. No exact valuation can be placed on this condition, but it may be one of the reasons why wheel damage is greater on one division than another. Curves also affect the service obtainable from wheels.

Design and Condition of Equipment

This is another factor which has a definite effect on wheel life, but which cannot be evaluated exactly.

It is known that in severe tender service the wheels on the front axle of the front truck develop more than their proportionate share of shelling, and in general the wheels in the front truck suffer more than the wheels in the rear truck. Similarly, wheels in some locomotive trailer trucks suffer an undue amount of damage under wheel loads which are not excessive for wheels in other positions.

The design and condition of the springs will affect the increase in load produced by impact. This effect will also be increased by any increase in the amount of unsprung weight carried by the wheels.

In conclusion, it is pointed out that intermediate factors, some of which have been noted, make it impossible to specify definite wheel loads which will be universally satisfactory. Loads low enough to avoid trouble under all conditions would be uneconomically low for many conditions. It is hoped that the railroads will study the results obtained in service by wheels to the Tentative Specifications and that with this experience they may be able to develop limiting wheel loads appropriate to their individual conditions.

The report was signed by H. W. Coddington (chairman), chief chemical and test engineer, Norfolk & Western; D. Wood (vice-chairman), engineer tests, Southern Pacific; E. E. Chapman, mechanical assistant, Atchison, Topeka & Santa Fe; W. R. Hedeman, engineer of tests, Baltimore & Ohio; J. Matthes, chief car inspector, Wabash; A. M. Johnsen, engineer tests, Pullman Company; E. C. Hardy, assistant engineer, New York Central; A. G. Hoppe, assistant mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific; and H. H. Haupt, general superintendent motive power, Central region, Pennsylvania.

Discussion

A member from a southern road directed attention to paragraph (3b) of the tentative specifications M-403-39, in which the specification says: "Drawn hubs will be accepted in a reasonable percentage of the total wheels presented for inspection . . ." The speaker suggested the deletion of the words "reasonable percentage" on the ground that it was not specific and that if any wheel involving such a condition were acceptable, why should not all wheels be acceptable. He suggested a more specific basis of rejection. At the close of the discussion the committee chairman explained that the reason for including this phrase in the report was to provide a rejection basis when

individual conditions seemed to warrant such action. The first speaker referred to also raised some question as to the sulphur content of wheel iron, making the comment that if a maximum of 16 points of sulphur were acceptable in some instances, whereas the specifications call for 14 points, why should not the 16-point maximum be acceptable in all cases.

(*The report was referred to letter ballot.*)

Report on Brakes and Brake Equipment

During the past year your committee has been actively engaged in a number of very complex and much involved subjects, some of which will require considerable further study before satisfactory conclusions and recommendations can be determined. However, we submit the following report for your consideration.

Cleaning and Testing Type-AB Brakes

With the approval of the General Committee a short time ago, Sec. E of the Manual was revised, at which time substantial matter with reference to codes of tests and other items that are more or less subject to revision from time to time were deleted, inasmuch as they were a duplication of information contained in the respective air-brake manufacturers' pamphlets.

In this connection, the instructions covering the proper procedure to follow when cleaning and testing Type-AB brakes have been revised and were approved by the brake committee at its last meeting. These will appear in pamphlet form as published by the brake manufacturers and will be available for all those engaged in this work.

Although these instructions will appear under the sponsorship of the air-brake companies, they are issued with the committee's approval and will not be changed, modified, nor revised in any way without formal approval of the association.

Single-Car Test Devices and Test Codes

A few years ago some member roads complained that the present single-car test device with its code of tests would, under certain conditions, reject a Type-K triple valve that had successfully passed the 3-T triple-valve test-rack code of tests. A subcommittee confirmed these complaints and then considered revisions to the code of tests, also the test device. With the assistance of the brake companies, a revised code of tests was prepared which, in practice, proved more or less inconvenient and difficult to carry out.

New single-car testing device

Inasmuch as the existing single-car test device could not be modified to remedy the conditions complained of, a further study revealed that a new design could be built that would be suitable for testing the brakes on any freight car of existing length and brake-pipe volume, as well as present passenger-car equipments.

The new design has been built and appropriate codes of tests prepared. It is our recommendation that this new design of single-car test device with its respective codes of tests be adopted as an Alternate to the present recommended practice device in order to obtain a wider experience with the new features it contains before offering such a device as a standard.

Modification of Freight Retaining Valve

In the committee's report last year reference was made to the present type of wasp excluder, also redesigning of the retaining valve to provide for larger passageways and additional protection.

The air-brake companies have submitted a further improved design of wasp excluder for application to existing retaining valves. Also a new design of retaining valve in which complete protection is provided against mud-wasps, together with complete protection against ice, sleet or other elements. However, some further consideration is necessary in connection with this new design and our recommendations with respect to it will be submitted in due course.

Since the last annual meeting complaints have been received of wheel troubles due to moisture entering the retaining valve, causing corrosion and stopping up the small relief port in the low-pressure cap. To remedy this, a molded rubber sleeve has been devised to fit over the low-pressure cap to protect the relief port.

The brake companies are now prepared to supply the latest design of wasp excluder and we recommend that it be accepted as an alternate to the one now generally used in order that a sufficiently wide application can be had definitely to determine its effectiveness in service.

We further recommend this design of molded rubber sleeve as a protection for the relief port so that a sufficient quantity may be applied to determine its effectiveness in service.

Standard and Lightweight Brake Beams

Since the No. 15 brake beam was adopted as standard, we have received several requests, principally from manufacturers, for approval of especially designed so-called lightweight beams for application to lightweight cars. These lightweight beams differ from the standard to the extent that most, if not all, their component parts are not interchangeable with it. In addition, they employ alloy materials.

The adoption of such a lightweight beam would involve a separate brake-beam specification and extensive revisions to the rules of interchange. In view of the fact that the only attractive feature in such a beam, and a very minor one, is a reduction in weight amounting to about 80 pounds per car set, any benefit in this direction would be more than offset by the inconvenience in effecting repairs in interchange and we are opposed to the introduction of any type of special design of lightweight beam unless all its component parts will interchange with the present standard.

The preparation of a standard No. 3 or No. 18 brake beam is well under way and our recommendations will be forthcoming in the very near future.

Brake-Head and Shoe Gages

In 1934, a price was established in the interchange rules covering the application of the standard A. A. R. brake-shoe key in repairs which was modified in 1935, resulting in a more general application of a properly dimensioned key. This has brought to light the fact that, when this standard key is driven down, it frequently damages the lug or loop of the brake shoe. To relieve this condition, we recommend two minor changes to the GO and NO-GO gage for the brake head shown as Fig. 3, page B-10-1936 of the Manual changing dimension *D* from ½ in. to $^{29}/_{64}$ in. and dimension *E* from $^{13}/_{32}$ in. to $^{25}/_{64}$ in., respectively.

Power Brakes for High Speed Passenger Trains

The development and introduction of various designs of streamlined light-weight trains employing different types of brake equipments seemed to warrant deferring committee action pending the results obtained in service with them. In addition, and more recently, considerable activity appears in the development

of new and somewhat radical designs of brake arrangements of the disc, rotor and drum types, together with further improvements in valvular mechanisms.

From what we know, such new streamlined trains that are fitted with electro-pneumatic brakes, foundation brake gear of latest design, anti-wheel-sliding devices and effective means of sanding properly all wheels in the train simultaneously with the brake application, may be brought to a stop from a speed of 100 m.p.h. within the distance requested by the Bureau of Safety. As we understand it there are but few such trains in service; therefore, the problem pertains primarily to trains consisting wholly, or in part, of conventional units in high-speed train service.

Our committee is convinced that present conventional passenger trains cannot be brought to a stop in 1,200 ft. from 60 m.p.h. with the distance increasing at higher speeds in proportion to the square of the speed, or even within 3,600 ft. from a speed of 100 m.p.h.

Obviously, there are two basic problems involved—first, how can the necessary rate of retardation be obtained and, second, if and when it is obtained, will the rail-wheel adhesion be so encroached upon as to cause intolerable wheel sliding? If so, how can the latter be avoided without sacrificing the former? The answers to these basic problems are not so easily found as may at first appear. Physical limitations are very definitely before us in certain phases of this study; in others, only partial and minor assistance seems possible. We are, however, investigating every feature involved, including the mass of data compiled from the various and numerous high-speed train brake tests made from 1913 to date in the hope of realizing the objective set for us with the least possible disturbance and revision to existing fundamental brake schedules and arrangements. Whether this is practicable we cannot at this time say.

We expect to be in a position to report more definite progress in the near future. In the meantime, the foregoing is submitted for your information.

Manual Duplex Release Valve

It appears there are two features in the Type-AB release-valve stem about which complaints have been received. One is that the release-valve stem is too slender in design to withstand the conditions imposed upon it. The other is that when the release valve is pulled wide open from the short release rod and near the valve to bleed both the auxiliary and emergency reservoirs, dust, gravel, cinders, etc., are blown into the operator's face and eyes.

The air brake manufacturers have redesigned the stem, strengthening it very materially and at the same time have provided a deflector plate just below the release-valve opening which deflects the blast of air away from the operator immediately the air is released.

We are satisfied both these improvements are desirable, and it is our recommendation that this latest design be supplied on all new Type-AB valves as soon as the brake manufacturers can provide it and that it also be applied to existing Type-AB valves when release-valve stem renewals are made.

The question of permission to renew detail parts or portions of Type-AB equipment when the stenciling is in date and the brake operative was referred to our committee for advice. It is our unanimous opinion that, where it is necessary to give any attention to either portion of the Type-AB valve or the brake cylinder, the entire brake should be given attention in accordance with Interchange Rule 60.

Location of Angle Cocks on Long Freight Cars

It was brought to our attention that the present standard dimensions covering the location of angle cocks as shown on page 31—1928, Section E of the Manual was not satisfactory for long freight cars and that when located to these dimensions much trouble and inconvenience is occasioned around industrial and mill tracks. After investigating the matter we agree they are not satisfactory for such operating conditions and should be revised.

(The committee recommended changes in Fig. 1 on page 31 of Section E of the Manual, the principal revision lowering the angle cock 1½ in. Otherwise the dimensions as now generally followed remain the same with maximum and minimum limits. —Editor.)

Where the angle cock is located at or near the horizontal minimum, interference may be experienced with the horizontal draft key, and this matter will be taken up with the Committee on Car Construction to see what can be done to avoid the necessity of relocating the brake pipe immediately back of the angle cock.

Lubrication of Air Brakes

During the past year serious consideration has been given to the question of satisfactory lubrication of car air-brake equipment, which includes lubricating oil for valve pistons, bushings, rings, etc., dry graphite for slide valves and seats, and grease for the brake cylinders.

The present standard rules of maintenance specify that the Type-AB valve pistons, rings, bushings, etc., must be lubricated with an approved kind of oil that the brake cylinder must be lubricated with a suitable brake-cylinder lubricant, but we have not yet specified what an approved oil or suitable brake-cylinder lubricant must be. The result is that many railroads are using various grades of oil and grease which are entirely unsatisfactory.

The number of Type-AB valves that are given attention as per Interchange Rule 60 before they have seen even two years' service provides ample evidence that the inferior kinds of lubricants used are primarily responsible. There is no doubt in our minds that, where satisfactory lubrication is practiced, the Type-AB brakes will give satisfactory service for at least three years but, unless approved lubricants are used, they cannot run their present allotted time.

The duration of service expected from these brakes demands special consideration in this respect and, when our recommendations are submitted, we shall, in all probability, ask for the adoption of strict regulations to ensure the economy anticipated by the adoption of these brakes as Standard.

Periodical Attention to Hand Brakes

It has been suggested by a member road that attention to geared hand brakes should be more definitely provided for in the Interchange Rules in order that they be attended to along with some other item given periodical attention.

The present rules for Maintenance of Brake and Train Air Signal Equipment, item 103, provides for the necessary attention to hand brakes on cars on shop or repair tracks with stencils "in date," but there is no regulation covering the same when cars are on shop or repair tracks for periodical attention to air brakes.

The joint subcommittee on geared hand brakes recommends the following paragraph be inserted as a new Sec. (n) to Interchange Rule 60: "(n) When car is on shop or repair track for air-brake cleaning and testing, the hand-brake mechanism and connections must be inspected, repaired and lubricated if necessary and tested to insure it is in suitable condition for safe and effective operation."

Maintenance of Train Air-Signal Equipment

The Bureau of Safety, Interstate Commerce Commission, has requested that steps be taken to incorporate in the rules for "Maintenance of Brake and Train Air Signal Equipment" definite requirement regarding the train air-signal equipment and that necessary improvements be made in the train air-signal equipment to insure its proper functioning. A subcommittee now has the matter under consideration.

Hose Clamp Bolts

Attention has been drawn to the practice of some roads when mounting hose square nuts are being used instead of hex nuts as shown for the air hose on page 16, Sec. E of the Manual. This is intended to show only the location of the hose label and the correct mounting position of the bolting lugs or clamps. It is immaterial whether square or hex nuts are used.

In addition to the foregoing, the following items are among those under active consideration by our committee: Air-hose couplings and gages for air-hose couplings; maintenance of brake beams and their attachments; charging time limit for AB valves on repair tracks; corrosion of air-brake equipment; maintenance of passenger-car metallic connections and gaskets; reclamation

of brake levers and inspection and tests of D-22 control valves.

We also wish to record our appreciation of the valued assistance given by the air brake companies on subjects jointly discussed with them; also, for their laboratory facilities in which considerable study was made.

The report was signed by W. H. Clegg (chairman), chief inspector air brakes and car heating equipment, Canadian National; T. L. Burton, air-brake engineer, New York Central; C. H. Rawlings, general air-brake instructor, Denver & Rio Grande Western; R. C. Burns, general foreman, Pennsylvania; L. S. Ayer, general air-brake inspector, Southern Pacific; J. P. Stewart, general supervisor air brakes, Missouri Pacific; R. E. Baker, general air-brake inspector, Boston & Maine; R. J. Watters, general air-brake inspector, Northern Pacific; J. A. Burke, supervisor air brakes, Atchison, Topeka & Santa Fe, and Otto Swan, air-brake inspector, Union Pacific.

Discussion

The committee chairman, after his presentation of the report, read a supplement to the 1939 report which was added with the idea of minimizing the damage to air-brake hose as a result of couplings pulling apart. This supplement read, in part, as follows: "In an effort to minimize this [damage] a minor change to the hose coupling and nipple has been suggested by the brake companies which the brake committee has approved. This change provides for distributing the stress in the air-hose fabric over an increased number of cords by increasing the radius of bearing for the inner surface of the hose when the air-hose couplings are pulled apart." This change in the dimensions of fittings affects only new fittings purchased and does not affect the status of existing fittings.

(*The report was accepted and the recommendations referred to letter ballot.*)

Report on Labor and Material Prices

In order that the rules may currently provide an equitable basis for inter-road billing, the committee has continued the work of analyzing material, labor and new equipment costs in A. A. R. Interchange Rules 101, 107, 111 and 112 of the Freight Car Code, and Rules 21 and 22 of the Passenger Car Code, with a view of determining and recommending necessary changes to be made in the next supplement to the current code.

Freight Car Rule 101

All miscellaneous material prices in Rule 101 were rechecked as of March 1, 1939, quotations submitted by the purchasing agents of the ten selected railroads, representing 39 per cent of total freight-car ownership in the United States and Canada, indicating a rather mixed trend in material markets as indicated by detail recommendations for revisions shown under this rule.

New Item 114-A is added to provide charge for high-tensile steel castings when standard to car. Item 188-D modified to make clear that charge for high-tensile steel is permissible only providing such material is standard to car.

Item 121 modified to clarify the intent.

A new second note is added to Item 155-A, to indicate the intent that the additional charge for removal and replacement of monogram plates, sign plates or placard holders secured to doors, is proper in connection with door renewals.

Item 160 is modified to clarify the intent that allowance specified for hatch plug for refrigerator car does not include chain and chain bolt.

Item 182 is modified to provide a charge for ratchet wheel shims applied in order to correct loose or worn condition between ratchet wheels and square fit brake shafts, and thus avoid the additional expense that would be incurred if brake shaft was removed, repaired and replaced or renewed, as recommended by the Arbitration Committee and the Committee on Brakes and Brake Equipment.

A new second note is added to Item 194-A to definitely indicate the intent with respect to charges and credits for multiple-wear wrought-steel wheels originally over 33 in. in diameter, which have reached condemning limit for passenger service and been assigned to freight service.

The second sentence of the first note under the heading "Friction Draft Gears" is modified to clarify. One new conditionally approved type of draft gear, Waugh-Gould 410, has been added to Section I of the draft gear table, together with a note explaining just what "conditionally approved" signifies and that such gears are to have the same status as approved types insofar as substitutions, charges, credits and other provisions of the Rules are concerned. Two new types of Peerless gears have been added to the non-approved section of the table and a clause inserted to indicate that prices listed for all four Peerless non-approved types of gears are exclusive of springs, spring rods, spring caps and cotters; the note following Item 277 being modified to harmonize.

Weights of brake hangers, brake levers and brake connection rods other than bottom rods, appearing in table of weights of miscellaneous items, have been increased 2 lb. each.

Interpretations Nos. 4 and 7 have been modified to clarify.

Rule 107

New Item 102-A added, to provide equitable allowance for renewal of journal box rivets in cases where side frames with Vulcan journal boxes are secured with rivets instead of bolts, in connection with removal, repair and replacement of journal box, truck side or wheels.

The second note following Item 48 modified, new third note added to Item 126 and a new note added to Item 296, to clarify the intent.

Rule 111

No modifications are recommended in this rule.

Rule 112

Recommendations are made in this rule respecting reproduction pound prices of new freight cars of all classes, in order that the supplement of August 1, 1939, may reflect 1938 costs in lieu of figures shown in the present code. New prices recommended are based on costs of 8,847 freight cars constructed during the year 1938.

Passenger Car Rule 21

In order to eliminate controversy and correspondence, a new note is added to Item 7 of this rule to indicate definitely where allowances for removal and replacement or renewal of bolts are applicable.

Items 20-B and 20-C are modified to clarify the intent that allowances specified for cleaning, oiling, testing and stenciling P. C. and U. C. control valves, include labor of making necessary repairs.

Item 20-K was modified to clarify the intent that this item does not apply to manually-operated slack adjusters.

Passenger Car Rule 22

Item 21 was modified to clarify the intent that same applies only to journal box lubrication and does not contemplate lubricating of pedestal, center plate and buffer stem oil cups, etc.

The notes following Item 41 have been numbered as Notes 1 and 2 and wording of Note 2 modified to clarify.

New Item 44 added to provide net charge for vestibule curtains applied complete.

As a result of questions raised in connection with present labor allowances for various rivet and jacking operations, the committee has arranged to conduct time studies on representative railroads in various sections of the country. If modifications are found necessary, revision will be made in the 1940 code.

It is the intent of the committee to investigate labor and material costs again in October and if sufficient change develops, necessary revision will be made and inserted in the rules effective January 1, 1940.

[The changes recommended in the existing rules are shown in detail in the report.—EDITOR.]

The report was signed by A. E. Calkins (chairman), superintendent of equipment, New York Central; A. E. Smith (vice-

chairman), vice-president, Union Tank Car Company; J. D. Rezner, general car foreman, Chicago, Burlington & Quincy; P. Kass, superintendent car department, Chicago, Rock Island & Pacific; T. J. Boring, general foreman, M. C. B. clearing house, Pennsylvania; H. H. Boyd, assistant chief motive power and rolling stock, Canadian Pacific and A. H. Gaebler, superintendent car department, General American Transportation Corporation.

(*The report was adopted.*)

Report on Tank Cars

During the past year the committee considered a total of 315 dockets and applications for approval of designs as follows: 157 covered designs, materials and construction of 2,176 new shipping containers for application to new cars or for replacement on existing cars of 17 classes. The five classes with the largest number of tanks were I. C. C.-106-A-500, 1202 tanks; I. C. C.-103, 324 tanks; I. C. C.-103-W (fusion-welded seams), 170 tanks; I. C. C.-105-A-300-W (fusion-welded seams), 100 tanks, and I. C. C.-105-A-300, 95 tanks.

Two applications covered five multiunit cars to be used for the transportation of 15 Class I. C. C.-106-A-500 one-ton containers each. Six applications covered 20 new underframes and trucks on which would be mounted existing tank-car tanks.

A total of 110 applications covered alterations in, additions to or conversions and reconditioning of 1,382 existing tank cars of 13 different classes.

Thirty-five applications requested approval of tank-car appurtenance designs, without reference to specific cars.

Specifications for Tank Cars

The committee has completed a proposed general revision of the Interstate Commerce Commission specifications for tanks to be mounted on or to form part of a car, referred to in our last report. This proposed general revision has been submitted to the commission for the necessary further handling.

Specifications for Fusion Welded Tank Car Tanks

The committee is at present engaged in a general revision of the specifications for fusion-welded tank car tanks, as submitted to the I. C. C. in 1934. When completed these revised proposed specifications will be submitted to the commission, along with reports covering service performed by existing fusion welded tanks in dangerous commodity service. The committee will, at the same time, in view of the satisfactory service performance of the tanks so fabricated, recommended the adoption by the commission of these proposed revised specifications.

Fusion-Welded Tank Car Tanks

Since the public hearings before the I. C. C., at Washington, D. C., on September 5, 6 and 7, 1934, on the matter of fusion-welded tank-car tanks the commission has authorized the construction of a total of 708 tank-car tanks, fabricated to conform to the proposed specifications then submitted, and their use in experimental service trials in transporting dangerous commodities.

To date 233 of these fusion-welded tanks have been constructed and placed in experimental service trials.

Two of the cars on which these tanks were mounted have been involved in wrecks resulting in considerable damage to the car structure, tank insulation and jacket. The fusion-welded tanks however suffered no apparent injury and after being subjected to hydrostatic tests and a thorough examination were returned to the service authorized by the commission's orders.

One fusion-welded tank failed as the result of a progressive fracture in the bottom sheet due to an internal defect impossible of detection by any ordinary method of inspection. This fracture, 3 in. long, including the initial internal defect in the sheet, was located on the transverse center line and extended circumferentially in the tank sheet, from the junction of the anchor-rivet-cover side wall with the tank shell, toward the sump. It was approximately 6 ft. from the single horizontal and a similar distance from the two circumferential fusion-welded seams of the middle course. The subcommittee appointed to investigate the failure of this tank were of the unanimous opinion it was not due to the use of fusion welding in the fabrication of the tank.

Service reports are regularly received covering all fusion-welded tank-car tanks authorized for experimental trials. These indicate a satisfactory performance for the fusion-welded tanks now in service.

One riveted aluminum tank has been constructed and placed in experimental service trials transporting dangerous commodities on authority of the I. C. C.

The report was signed by G. S. Goodwin (chairman), mechanical engineer, Chicago, Rock Island & Pacific; F. A. Isaacson (vice-chairman), engineer car construction, Atchison, Topeka & Santa Fe; A. G. Trumbull, chief mechanical engineer, Chesapeake & Ohio; G. McCormick, general superintendent motive power, Southern Pacific; W. C. Lindner, chief car inspector, Pennsylvania; A. E. Smith, vice-president, Union Tank Car Company; G. A. Young, head, School of Mechanical Engineering, Purdue University; F. Zeleny, engineer of tests, Chicago, Burlington & Quincy; W. C. Steffa, transportation manager, Sinclair Refining Company; R. T. Baldwin, secretary, The Chlorine Institute, Inc.; H. J. Gronemeyer, supervisor car equipment, E. I. DuPont deNemours & Co., Inc.; and R. W. Thomas, manager, Philgas department, Phillips Petroleum Company.

(*The report was accepted.*)

Report of Committee on Loading Rules

Since the last convention held at Atlantic City in 1937, your committee has held several meetings with the shippers, at which time recommendations for changes and additions to the loading rules were considered. In addition to this, several meetings were held by the committee as a whole, as well as the sub-committees, to consider and formulate rules based on recommendations submitted by the shippers and member carriers.

Considerable experimentation of trial loads embodying new forms of loading have been tried out, notable of which involved the steel and lumber industries. These loads have been followed to destination so as to determine their feasibility insofar as safety and practicability of such loadings, with very gratifying results.

The committee wishes to extend to the shippers and member carriers its sincere thanks for the splendid cooperation it has received in its work and is indebted to their representatives for their very able assistance.

As the result of these deliberations, your committee submits the following recommendations covering changes in the rules for your approval and submission to letter ballot for adoption by the Association.

General Rule 1

Change the next to the last sentence to read: "Shippers must confer with originating carriers regarding safe loading of material not covered in these rules, and exacting care must be exercised to see that the details specified in Rules 1 to 21, inclusive, are fully complied with."

Reason: To more clearly indicate what is desired.

General Rule 3

Change to read as follows: "Clearance—Side Bearing—Loaded Cars.—There must be sufficient clearance between side bearings to permit free curvature of trucks and the average clearance per side bearing should not exceed ¼ in."

Reason: To reduce shopping of loaded cars for side-bearing adjustments in transit.

General Rule 20

Change first sentence to read: "When loading material (metal or stone) which is short enough to drop through door openings in gondola cars, and which is not of such character as is in-

tended to be unloaded through the drop door openings (stone larger than ballast, fluxing, and small stone, or metal other than borings, turnings, loose tin and sheet steel cuttings not more than ⅛ in. thick), the door openings must be covered with boards not less than 2 in. thick, secured to prevent displacement."

Reason: To retain boards in original position.

Instructions—Experimental Loads

Insert new paragraph between paragraphs 3 and 4 to read as follows: "Shipper, after having received authority for experimental shipments, will be furnished stickers worded as outlined below. He will affix one to bill of lading and attach another to be affixed to waybill by agent. This to insure proper handling of experimental load cards."

Reason: To insure proper handling of experimental load cards.

Sticker for Bill of Lading and Waybill

The Association of American Railroads, through the Committee on Loading Rules, has authorized the application of experimental load cards to Car..... These cards must be removed at destination by Car Inspector or Agent who must answer the questions on one of the cards and send it to the Secretary, Mechanical Division, Association of American Railroads.

[The rest of this report was devoted to recommendations covering proposed changes in details of various types of loading as illustrated in Figs. 2 to 209-A of the loading rules. New minimum requirements are given in detail for such commodities as plain steel plates, wire mesh or bar mats, rolled wire mesh, mounted car wheels and tractors with pneumatic tires.—Editor]

The report was signed by W. B. Moir (chairman), chief car inspector, Pennsylvania; C. J. Nelson (vice-chairman) superintendent interchange, Chicago Car Interchange Bureau; R. H. Dyer, general car inspector, Norfolk & Western; H. H. Golden, supervisor; A. R. A. Interchange and Accounting, Louisville & Nashville; H. S. Keppelman, superintendent car department, Reading; T. W. Carr, superintendent rolling stock, Pittsburgh & Lake Erie; and A. H. Keys, district master car builder, Baltimore & Ohio.

Discussion

In discussing this report C. J. Nelson, superintendent of interchange, Chicago Car Interchange Bureau, said that the drastic speeding up of freight trains has greatly increased the necessity of safe loading of commodities on open-top cars and that necessary rule revisions must be made from time to time to increase the safety of train operation. Formerly these revisions which increased the strength and, to some degree, the cost of loading were accepted freely by shippers, but, under present highly competitive conditions shippers will not agree to pay the increased cost unless they can be shown that it is absolutely necessary.

To illustrate this point, Mr. Nelson said that lumber loads present the greatest possibility for failure in transit and that the committee's recommendations for increased strength in loading methods could not be made to stand up with lumber shippers, because the committee lacked sufficient specific data to prove the urgency of the rule revisions. In an attempt to develop this factual information, the committee sent out questionnaires to 300 roads and received replies from only 72. Mr. Nelson said that unless better cooperation is secured from individual roads in providing this information, the work of the committee will be largely nullified.

Mr. Nelson also urged a closer adherence to the loading rules and a discontinuance of the practice now far too generally followed of accepting cars from shippers not loaded in accordance with the rules. In support of this statement Mr. Nelson cited the case of a large crane loaded on a flat car and secured in place with eight strands of ⅛-in. wire, instead of 1¼-in. to 1½-in. anchor rods as recommended. Many other instances of rule violations could be mentioned.

An appeal was also made for more cooperation in properly filling out and returning the experimental-load cards, only 10 per cent of which now get back to the committee and some of these convey only a small part of the information requested.

Mr. Nelson said that shippers generally are entirely agreeable to go along with somewhat increased loading costs in the interests of greater safety when they can be convinced of the real necessity for the increase. In closing his remarks, Mr. Nelson paid tribute to Secretary Hawthorne's invaluable help in maintaining favorable relations with shippers and convincing them that the committee is earnestly endeavoring to work in their interest, as well as that of the railroads, in promoting safe loading practices at minimum practicable expense.

(*The report was accepted and referred to letter ballot.*)

Report on Specifications For Materials

The committee during the past year has reviewed all of the material specifications and considered comments and criticisms submitted by the members and others. The following revisions are submitted for your consideration:

Specification M-101-37—Axles, Carbon Steel, for Cars and Locomotive Tenders.—The scope of this specification has been revised to include axles up to and including Class E instead of up to and including 6½ in. in nominal diameter at the center.

Specification M-108-37—Boiler Tubes, Lap Welded, Electric Resistance Welded, and Seamless Steel, and Lap-Welded Charcoal Iron.—This specification has been revised to include specific reference to electric resistance welded tubes and to include a thickness tolerance specification for tubes manufactured by this process.

Specification M-111-36—Pipe, Furnace-Welded, Electric Resistance Welded, and Seamless Steel.—A number of typographical revisions and changes in A. S. T. M. and A. S. A. references to agree with the latest revisions were recommended.

Specifications M-302-37, M-304-36, and 305-36.—The first of these specifications covers refined wrought-iron bars, in which a typographical correction is noted which has already been made in the Manual. The other two specifications cover hollow-rolled and solid staybolt iron, respectively. Reference to iron scrap has been removed from the definition section of these two specifications.

Specification M-402-34—Malleable Iron Castings.—The following sentence has been added to the process section of the specifications: "Castings shall be free from primary graphite."

Specification M-911-39—Brushes.—This is a new specification which has been written to cover brushes—bristle, hair, fibre, and wire. The specifications cover paint and varnish brushes for master painting and utility purposes in general railroad use, as well as roofing, scrub, wash, duster, and wire brushes which are in general use.

Specifications for Car Oil and Renovated Journal-Box Packing.—As a result of joint conferences of the Committee on Specifications for Materials and the Lubrication Committee, revisions and new specifications have been prepared covering reclaimed car oil, new car oil, and renovated journal-box packing. Specification M-904-39—Renovated Car Oil—has been completely rewritten to include detailed instructions on the procurement and handling of samples and methods of analysis. The properties of car oil, recovered from used journal-box packing after passing through the renovating process, which are acceptable under the specifications are shown in the table. Specification M-906-39—New Car Oil—has also been completely rewritten to include more details of methods for sampling and analysis. The prop-

Required Properties of Renovated Car Oil Recovered from Used Journal-Box Packing

Items	Requirements
(1) Flash (open cup)	Not less than 300 deg. F.
(2) Saybolt univ. viscosity at 210 deg. F.	Not under 45 sec.
(3) Saybolt univ. viscosity at 100 deg. F.	Not over 725 sec.
(4) Water	Not over 0.20 per cent
(5) Total impurities, including tarry matter	Not over 0.75 per cent *
(6) Qualitative test for mineral acidity	Zero
Qualitative tests for alkalinity	Traces

* Lead and lead compounds will not be considered as impurities. Total lead in impurities shall be calculated as lead oxide (PbO) and subtracted from total impurities.

erties specified, however, have not been changed except for the addition of the requirement that the oil must be neutral to methyl orange and phenolphthalein. New Specification M-910-39 covers renovated journal-box packing. This includes the general subject matter now covered in Rule 66 and in Methods of Analysis of Reclaimed Waste—Section L of the A. A. R. Manual, amplified as to details and methods of sampling and methods of analysis. The properties to which the renovated journal-box packing are required to conform are given in the table. Suitable revisions of Rule 66 and Section L of the Manual to conform with the new packing and revised oil specifications are also recommended.

Required Properties of Renovated Journal-Box Packing

Items	Packing
Clean dry waste	20 per cent min.
Total impurities (including tarry matter)	5 per cent max.
Water	2 per cent max.
Oil	Balance

NOTE:—Percentages, based on weight of original sample, as 100 per cent.

The report was signed by T. D. Sedwick (Chairman), engineer of tests, Chicago, Rock Island & Pacific; E. E. Chapman (Vice-chairman), mechanical assistant, Atchison, Topeka & Santa Fe; Frank Zeleny, engineer of tests, Chicago, Burlington & Quincy; H. G. Burnham, engineer of tests, Northern Pacific; H. P. Hass, engineer of tests, New York, New Haven & Hartford; J. R. Jackson, engineer of tests, Missouri Pacific; H. G. Miller, engineer of tests, Chicago, Milwaukee, St. Paul & Pacific; J. W. Hergenhan, assistant engineer, test department, New York Central; L. B. Jones, engineer of tests, Pennsylvania; C. R. Bryant, engineer of tests, Southern; and W. R. Hedeman, engineer of tests, Baltimore & Ohio.

(*The report was accepted and the recommendations referred to letter ballot.*)

Lubrication of Cars and Locomotives

Your committee has held one meeting during the past year at which time a joint conference was held with the Committee on Specifications for Materials to consider tentative specifications covering (1) renovated car oil and (2) renovated journal-box packing. These specifications were developed jointly by members from the two committees and the results are included in the report submitted by the Committee on Specifications for Materials.

The Committee on Lubrication joins the Committee on Specifications for Materials in recommending that Specifications M-904-39, Renovated Car Oil, and M-910-39, Renovated Journal-Box Packing, together with the proposed changes in Rule 66 of the 1939 Revised Code of Rules, and Page 35-B-1937, Section L, of the Manual be approved for submission to Letter Ballot.

A. A. R. Interchange Rule No. 66

It is appreciated that there has been some degree of improvement in the results obtained from better lubrication practices instituted with the adoption of A. A. R. Rule 66. Nevertheless, the anticipated benefits to be derived from the rule cannot be fully realized so long as cars are stencilled as being repacked without conforming to full requirements of the rule.

Despite the better performance record, there is great opportunity for further improvement when considering the effects and related costs resulting from burned-off journals, the cost of setting out a car enroute in a train, the complications from a traffic standpoint, and the cost of reconditioning damaged journals for continued service. Increased speeds to meet highway competition make the main objective one of uninterrupted train operation and to that end journal lubrication plays an important part.

To reflect some idea of the situation, the record for the year 1938 of one large eastern road shows 7,846 freight-car hot boxes with an average of 195,000 miles per hot-box failure. The total train detentions due to journal heatings amounted to approximately 2,800 hours. Of the total number of hot boxes, 47 per cent occurred on owned cars representing 74 per cent of the cars on line; 30 per cent on foreign railroad cars representing 17 per cent of the cars on line, and 23 per cent on private line cars, representing 9 per cent of cars on line.

It is the feeling of your committee that substantial improvements can be further realized if Rule 66, with modifications now being submitted for approval, and other related A. A. R. standards are adhered to. It should be noted that a new requirement is included in Rule 3 of the 1939 Code of Rules for the interchange of traffic to provide that, effective January 1, 1940, packing for journal boxes must be prepared and boxes repacked in accordance with A. A. R. standard practice, as defined in Rule 66, on all cars from owners. Furthermore, the necessity for strict compliance with the rule has been emphasized by letter of January 16, 1939, on behalf of the General Committee addressed to the members and car owners.

The time limit for periodic repacking of journal boxes is now fifteen months. The committee has been asked to consider a proposal to reduce that limit to twelve months, predicated on a study made by one member road of 1,783 hot boxes.

Using the data from this road to compare with a similar study made by a second member road to indicate in what elapsed time after the stencilled packing date heatings occurred, the following comparative statement is presented:

	Road A		Road B	
	No. of heatings	Per cent of total	No. of heatings	Per cent of total
Within 2 months	149	8.4	1,086	14.6
From 3 to 6 months, incl.	557	31.2	1,871	25.1
From 7 to 10 months, incl.	487	27.4	1,899	25.5
From 11 to 15 months, incl.	465	26.0	1,764	23.7
Over 15 months	125	7.0	830	11.1
Total	1,783	100.0	7,450	100.0

It should be noted that in the case of Road A 67 per cent of the total heatings occurred within ten months of the stencilled packing date and for Road B 65.2 per cent occurred within the same elapsed time.

It is generally recognized that journal-box packing of inadequate quality is a contributing cause of journal heatings. Stencilling of cars but failing to perform all the work as required by Rule 66; using improperly prepared packing or improperly applying good packing does not help to produce satisfactory lubrication performance.

Change of packing in the spring and again in the fall has been advocated but as this procedure would seem to be impracticable as well as costly, it is the opinion of the committee that before shortening the repacking period it would be advisable to comply with the accepted and recommended measures for protecting journal lubrication after which further data could be developed.

Method of Packing

In the method of packing boxes, some roads deviate somewhat from details outlined as standard practice in Rule 66, particularly for passenger service. One method employs loosely twisted rolls and another rolls without twisting. In both methods two, three, or four rolls as may be necessary, depending upon journal size, are applied with the ends tucked down at the side walls and no part of the packing extending above one inch below the center line of journal. These methods appear, when properly carried out, to result in a more nearly uniform application by the various box packers and according to reports, it has effected a noticeable reduction in the number of waste-grab cases.

Car Oil

Attention has been called to a number of axle journals found with pitted surface, particularly in the case of rolling stock that has been out of service for prolonged periods, making it necessary to machine-finish the journals before they are returned to service. The indications are that the pitting may be due to traces of acidity found in some mixtures of oil and waste, which, in the presence of moisture, forms a dilute acid which attacks

the steel journal. Some new car oils have been found to give an acid reaction and other car oils do not reflect such indication. It does not seem unreasonable to expect, under the present art of refinement, that all new car oils as well as renovated car oils shall be acid-free. One railroad system, and there may be others, rejects shipments of car oil on the basis of an acid reaction. Therefore, in the interest of taking steps to eliminate at least one cause for the development of pitted journals and to discourage a railroad from accepting an acid oil for use in interchange that another road has rejected, it has been recommended that Specification No. M-906-34, New Car Oil, be revised to contain a requirement showing neutral reaction to acid content.

It is well established that excessive water in journal boxes is a hazard to adequate lubrication, particularly in combination with dirt and other contaminations accumulated in service, and it is questionable that the demand for a water-free journal box assembly can be met within reasonable cost limits. Therefore, if any member has information to indicate that oils which separate almost instantly from water as contained in journal boxes are better lubricants than those which do not separate readily or vice versa, particularly in the presence of fine dirt, it would be helpful if such information could be furnished to the committee.

Waste

The quality of waste used for journal-box packing is a very important factor. Many roads use renovated waste in preparing packing for freight equipment. For passenger service all new, a mixture of renovated and new or all renovated waste is used quite successfully when the quality of the renovated materials are of a high order, in which case, in addition to the cleanliness of the waste, there is also the additional element of improvement due to the removal of the free lint and increased oil retention that renovated waste of this quality has over new waste.

Because of a wide divergence of opinions as to what constitutes a good grade of waste, the A. A. R. specification is necessarily broad, permitting many optional materials. Nevertheless, until such time as the range of grades can be narrowed to an acceptable standard, new waste should at least conform to A. A. R. Specification M-905-34.

Journal Bearings

Bearings with refinements in design, manufacture and finish known to be used in passenger service are those with lengthwise slots of various forms in the lining metal adjacent to edges for the purpose of trapping lint and waste strands; so-called "circulating," "vacuum," "self-cooling" and "oil-control" bearings provided with communications between the side slots through which excess oil passes, thereby aiding in the dissipation of bearing heat; milled back surface to insure a smooth bearing parallel with the broached journal surface and in addition to the milled surface, bearings with center depressions cast across the back are being used. This latter development is the result of tests which showed that even with a bearing with machined flat back there is a tendency for the bearing to warp under heat and produce a concentrated loading effect with the area which bears on the journal confined to the center. By virtue of the back center depression, the load on the journal is more evenly distributed through the full length of the journal bearing.

Wedges

In some instances, it has been the practice to reclaim wedges by reforging under a steam hammer, using dies for the purpose of restoring the convexity of the top surface and flattening the undersurface. This frequently produces unsatisfactory results.

A number of wedges have been found with the apex of the 78 in. radius crown coinciding with center line located at a point one-half the dimension of the overall length, which is one-half of dimension B shown on the wedge drawing or, in effect, a tapered wedge. This is contrary to the intent of the drawing which locates the apex of the crown at a point one-half the length of the surface that rests on journal bearing, or one-half of dimension A.

Despite the requirement in Rule 66 that the use of hollow-back or corrugated-back wedges is not permitted, such wedges have recently been found in service.

One road, and there may be others, has adopted the practice of machining the crown and the under face, also the back end, of wedges for passenger service. To reclaim wedges the surfaces are machined where necessary within limiting dimensions. This practice has resulted in restoring numerous wedges to passenger service that otherwise would have been diverted to freight or scrapped. Eventually such machined wedges will get into freight service.

Where machined-back journal bearings are used it is advantageous also to use a machined wedge.

The back end of wedges is commonly irregular and sloped due to the draft in dies. By using wedges with this end surface machined square with the under face, there has been a definite reduction in the number of broken bearing collars.

Journal Boxes

It is desirable that ceiling of journal boxes be flat; location and dimensions of stop lugs, and dust-guard well dimensions be in strict conformity with the A. A. R. requirements. Dust-guard well surfaces should be reasonably smooth; the lid hinge-pin lug should be in correct position and the flat machined or ground box mouth rim should be in proper position with respect to the center of the lug hole.

Badly worn hinge-lug contour can be restored by applying welding metal and grinding to proper shape. Worn lug hole can be restored to normal by welding and reboring or by securing a suitable steel bushing in place.

Dust Guards

The results of a survey made some time ago indicate that there is a need for substantial improvement in the dust guard. Although considerable study has been given to this complex problem, your Committee is not in a position to make definite recommendations with the view of adopting a more effective seal at this time. For freight equipment, the more effective sealing dust guards than the A. A. R. standard that are available are prevented from receiving favorable consideration because of their cost.

One member road, having in general use under passenger equipment a dust guard with a more effective seal, reports finding accumulation of water in journal boxes which was not found in boxes with less efficient dust-guard seals. However, the desirability of effectively sealing the back of the journal box against the loss of oil under extreme conditions of infiltration of water and dirt into the box is recognized as an improvement. With excessive water entering the front of the journal boxes, which was the case with boxes with dust guards tight enough to hold the water in, once it entered the box, the tight dust guard prevented the water floating the oil out the back of the box.

In roller-bearing boxes, the construction of which is relatively tight, water was also found by the same road which would indicate that it is a difficult problem to prevent the accumulation of moisture in a journal box.

In view of the importance of the problem, it is recommended as a minimum requirement that the top opening of the dust-guard well be sealed by plug or cap, provisions for which have already been adopted, and that well constructed dust guards, complying with A. A. R. requirements be maintained.

[The committee included a suggestion for a revised dust-guard specification M-903-34. New requirements in the proposed specification are that dust guards withstand submersion in water and in car oil separately at temperatures of 212 deg. F. for a period of 24 hours and specific reference to a number of defects from which the wood in dust guards must be free. Complete provisions regulating inspection, rejection, and rehearings have also been added.—Editor.]

It is recommended that the present Specification M-903-34 be continued in effect and that the foregoing suggested revision be circularized among the members of the Association with request that suggestions or criticisms be submitted for further consideration by the committee.

Box Lids

Attention is called to a requirement in Rule 66, paragraph 9, under the heading "Journal Boxes" to the effect that "when new journal boxes are applied, or when reapplying boxes, box lids complying with A. A. R. specifications shall be applied."

In connection with Specification M-120-35, covering the journal box lids, the committee has recommended that the outline of flat spring be deleted from the diagram shown on page 3 in order to avoid confusion with the requirement under par. 4 (b)

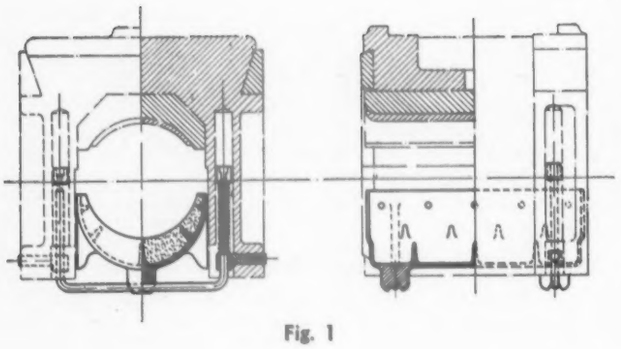


Fig. 1

which specifies "springs of the coil type to be used." This change will be made in the next revision of the manual.

As information, a few member roads are experimenting on passenger equipment with means for positively locking lids in closed

Fig. 2

position for the purpose of preventing vibration and to resist the raising of lids by ice formation between lid and box.

Axles

For this subject, including the finish and protection of journals, it seems sufficient to refer to the A. A. R. Wheel and Axle Manual which adequately covers all requirements thus far developed.

Truck Assembly

Details of design and mechanical condition of the entire truck assembly also have an important influence in acquiring successful lubrication performance. Observations of your committee and information coming to it indicate that control of lateral and the lubrication of the thrust bearing areas in conventional truck assemblies add to lubrication difficulties, particularly on roads having relatively numerous curves. That this is appreciated by one bearing manufacturer and by some roads experiencing increasing lubrication and maintenance troubles resulting from lateral is evidenced by activities during the past year in the modification of bearing and wedge design, and journal-box assembly tolerances with a view of controlling lateral thrust and wear, and improving service performance.

Your committee in this year's report has dealt with car oil, waste, bearing, wedge, box, dust guard, lid and axle details as separate items. It is of the opinion, however, that further improvement in journal performance through the correction of certain mechanical irregularities and changes in the design, manufacture, and maintenance tolerances of truck assembly details, which is not within its province, is a matter of sufficient importance to warrant study by a special joint sub-committee of members to be selected from the standing committees involved.

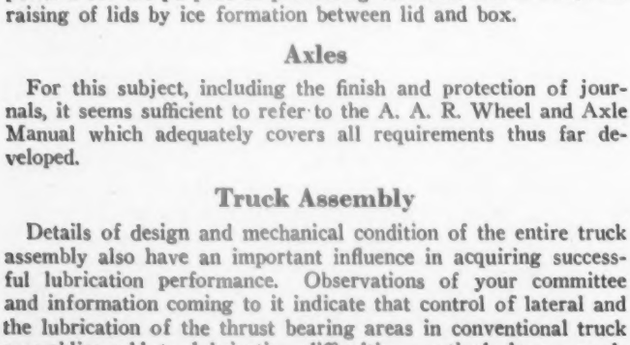


Fig. 3

Pursuing the matter of steam and Diesel locomotive lubrication, your committee prepared a rather elaborate and all inclusive questionnaire which was forwarded to thirty-nine Class I railroads, which railroads operate in excess of 80 per cent of the locomotives owned by all class one railroads, in an effort to determine various practices and approach to standard in the matter of lubricating various wearing parts of the locomotive. Replies were received from 34 railroads and the results tabulated, which has permitted this committee to draw the following conclusions:

Lubrication of Steam-Locomotive Engine Trucks

In general, the common standard on all roads replying for engine-truck lubrication, consisted of oil-saturated waste contained in a cellar. In twenty-nine cases prints were furnished and indicated that this cellar was fixed; that is, a solid container for the waste was provided and held in the engine-truck box with various types of retainers, keys or bolts. Two roads reported that they were using the spring-loaded design of engine-truck cellar (Fig. 1). This cellar consists of a cast-iron shell equipped with prongs designed to prevent the packing rolling, and the shell is packed with oil-saturated waste and held against the journal by a combination of yokes and coil springs. The advantage claimed for this design is that, it insures contact between the packing and the journal at all times. There is a further advantage in ease of servicing or repacking.

Where the rigid cast-iron box cellar is used there are various methods of securing the cellar in place, generally by means of a tapered slot in the box, the taper usually approximately one in eight, which receives a corresponding rib on the cellar. The intent is to compress the packing gradually as the cellar is

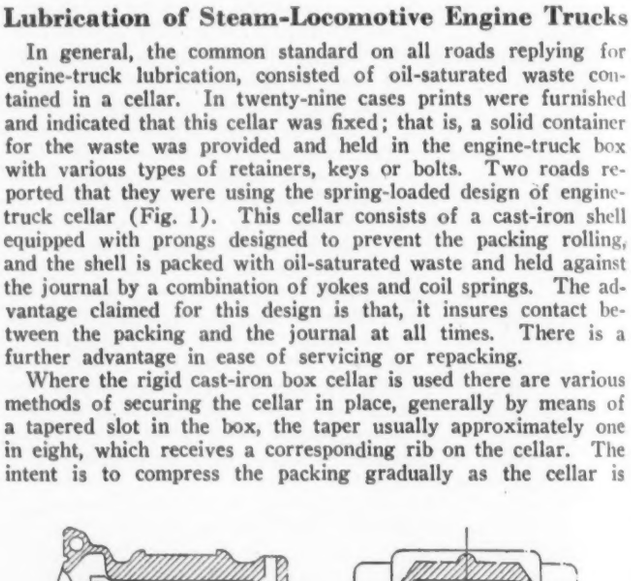


Fig. 4

forced into place. Many roads use a similar arrangement only with a horizontal tongue and groove.

There are a variety of methods of securing the cellars ranging from simple horizontal key bolts, diagonal key bolts and patented spring locks. Several roads indicated that they were using removable end plates in engine-truck cellars in order to facilitate servicing without removing the cellars. It was noted in such cases an oil well was provided in the cellar below the bottom opening of the end plate for retaining the oil.

The types of packing used range from one-hundred-per-cent wool waste to straight cotton packing. Two roads reported their common standard as a spring-loaded pad with feeders extending into an oil well in the bottom of the cellar with oil fed by capillary attraction (Figs. 2, 3 and 4); two roads reported oil and waste with auxiliary oiling from force-feed lubricators.

Practically all of the roads reported that engine-truck cellars are serviced each trip where oil and waste packing is used. A number of the roads reported that some special method of lubrication is provided for the engine trucks, such as spring-loaded pads (Fig. 2), a pad fed by an individual oil pump; the use of an air-actuated hand-operated pump and oiled waste (Fig. 6) or other mechanical force-feed lubrication for engine trucks. Twelve roads reported the use of roller bearings of several different designs on engine trucks.

While the vast majority of locomotives appear to be lubri-

cated with the waste-packed cellar, the efforts being made to improve lubrication, improve performance and reduce servicing costs, gives evidence that a change is generally desired.

In considering engine-truck lubrication the committee finds that there is a variation in practice as to application of lubrication. While it is generally applied to the cellar or waste packing, some roads still free-oil through a cavity in the top of the bearing. A number of roads have reported the use of specially designed so-called circulating bearings or lining of special composition as submitted by various manufacturers, but the extent of the use, considering the group of roads investigated, is not sufficient to permit of a conclusion.

There is a trend towards application of roller bearings to new power and the use of mechanical lubrication to oil-saturated waste in existing engine-truck installations.

Trailer Trucks

A summary of the replies with reference to standard design and practice for lubrication of trailer trucks in general corresponds with the information furnished covering engine trucks.

The standard practice for either outside or inside bearings appears to be a fixed cellar with oil-saturated packing with about the same variation between the grade of packing used as was evidenced in the survey of engine trucks. There appears to be less attempt to employ force-feed lubrication for adding oil to the cellar or packing than with the engine trucks.

Four roads reported the use of roller bearings on trailer trucks; seven roads reported a special type of lubricator, either a pad fed by an individual oil pump or several types of spring-loaded pads.

The most conclusive report on other than waste packing comes from one road which reported the adoption of a spring-loaded pad as a standard on heavy freight and passenger locomotives. They reported 103 passenger locomotives and 128 freight locomotives so equipped and advised that the service has been entirely satisfactory after a total operation of 52,000,000 locomotive miles.

Two roads reported rather extensive use of pads (Fig. 5),

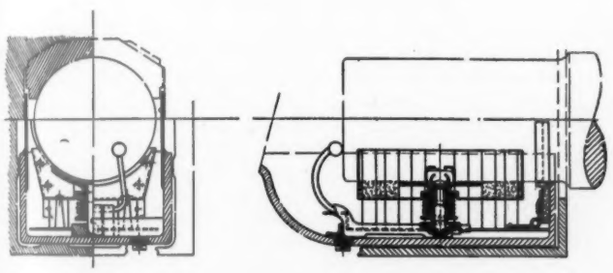


Fig. 5

fed by individual oil pumps, one road on 48 passenger and another on 78 passenger and 180 freight locomotives. One road reported satisfactory service and the other generally satisfactory service except for some breakage of parts and entrained dirt that stops up the oil passages.

Driving Journals with Oil Lubrication

From the replies made to the questionnaire there is evidence of an increasing tendency to substitute oil lubrication to driving journals in place of grease. Thirteen roads reported the use of oil lubrication in one form or another, exclusive of those utilizing roller bearings in this location. Four roads reported on nineteen applications of pads (Fig. 5), fed by individual oil pumps. Two roads reported on 162 locomotive applications (42 of these on all journals except main), of a spring-supported pad (Fig. 2). These applications have been made to locomotives in both freight and passenger service and satisfactory service has been reported on speeds in excess of 75 miles per hour in passenger service and 50 miles per hour in freight service for the above applications.

One road reported on force-feed lubrication of valve oil on a Pacific type passenger engine which is under test. Another road reported installation of waste-packed cellar, similar to engine truck, to a switch engine in November, 1937, for test purposes, and apparently the service to date has been satisfactory. Three

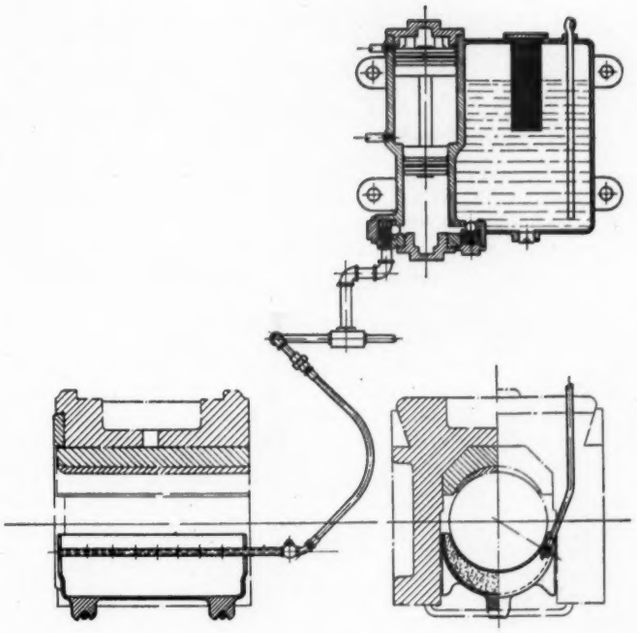


Fig. 6

roads reported on 54 locomotive applications of waste-packed cellars similar to engine and trailer trucks, and 46 of these locomotives are in slow speed heavy freight service.

There is a new development on the market, and now under test (Fig. 7). This incorporates a floating axle flooded in oil by a pump actuated from the movement of the locomotive and running in a bronze bushing, and a lateral device consisting of a collar forged into the center of the axle to which wear resisting plates are opposed and, like the journal bearing, flooded in oil. This, in effect, is a full floating axle. In view of the interest indicated in application of oil lubrication to locomotive driving journals, this device holds interesting possibilities, although to date tests have not progressed sufficiently to indicate the ultimate results that may be obtained.

Pump-fed and spring-loaded pads have undergone a rather wide range of tests. Some difficulties have been reported due to broken springs resulting in failure to keep the pad of either device against the journal, but in general the service has been quite satisfactory and apparently the difficulties are being gradually overcome.

Your committee recommends further study of the application of oil lubrication to locomotive driving journals for the reason that in addition to reduced friction through the use of oil in place of grease for journal lubrication, there is the advantage of lower operating temperature, less liability to stuck wedges and the possibility of diverting a portion of the journal lubrication to regularly and consistently lubricate shoe, wedge and lateral bearing faces.

Lubrication of Engine- and Tender-Truck Center Plates

Evidence of the interest devoted to improving lubrication of engine- and tender-truck center plates is evidenced by the fact that, of the 34 roads reporting, eighteen roads reported efforts to lubricate this bearing by other methods than the application of lubrication at various times when the castings are separated

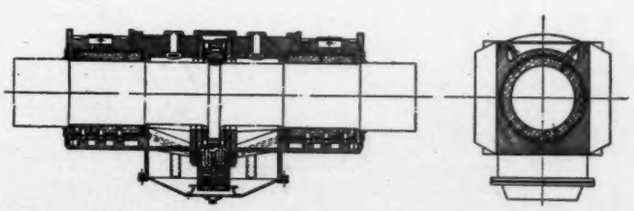


Fig. 7

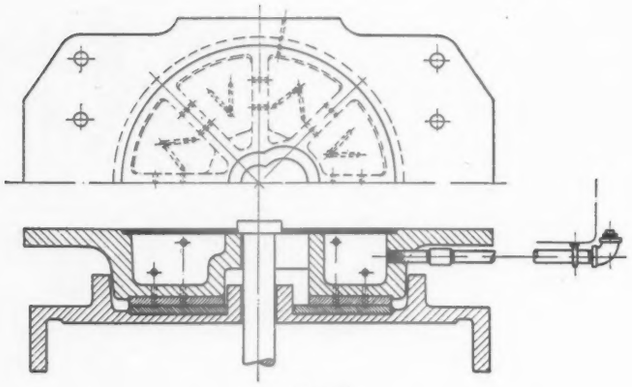


Fig. 8

by jacking, including soft-grease lubrication; oil cups; mechanical force-feed lubrication; bronze or hardened-steel wearing plates drilled for oil distribution, and the oil piped to enclosed cavities in the castings (Figs. 8 and 9).

Eighteen roads reported on the use of soft grease applied with a pressure gun to various systems of grooving which is used more extensively than any of the other improved systems reported upon, and from the reports of reduction in wear appears to be satisfactorily serving the purpose.

Radial-Buffer Lubrication

Twenty-four of the roads replying to the questionnaire indicated that they are using a different method of lubricating radial buffers other than hand oilers. All of the roads, with the exception of two, were using a soft grease applied from a pressure gun, and four roads reported the use of oil lubrication from special containers or from mechanical lubricators using splitters on some engines and soft grease on others. The use of soft grease has been standardized on at least eight roads, and one road uses crude oil.

Those who estimated a reduction buffer in wear were agreed on a fifty per cent reduction. In this connection, a number of roads have employed the use of a shield above the chafing casting in addition to the lubrication, in an effort to exclude coal dust and foreign particles from the wearing surfaces.

Drifting Valves

Fifteen roads out of thirty-four are using drifting valves on 1,842 locomotives. They indicated that the purpose of applying these drifting valves was to provide distribution of lubrication to valves and cylinders, while the locomotive was drifting, to reduce formation of carbon and provide some compression for cushion of reciprocating parts while drifting, and the replies for the individual roads vary from one locomotive on test to 316 locomotives in regular service.

Ten roads indicated definitely that the device had served the purpose of improving lubrication and reducing the formation of carbon. One road reporting on 283 drifting valves and 12 by-pass valves indicated the by-pass valves had functioned entirely satisfactorily, but the drifting valves had not proven entirely satisfactory when drifting at high speeds.

In answer to the question as to fuel saving, four roads reported no record; one road, operating 240 locomotives, indicated a doubtful saving, and the balance indicated they have found a saving in fuel.

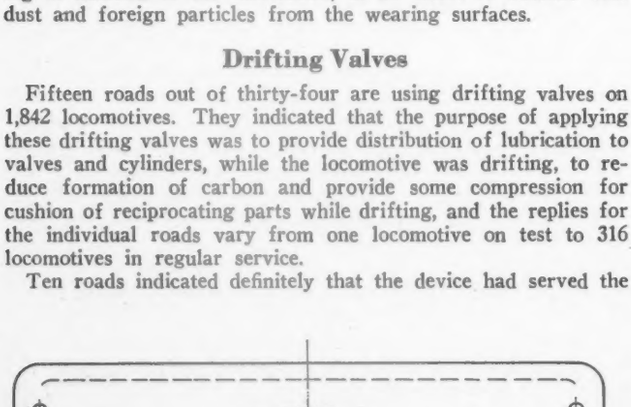


Fig. 9

Material for Valve and Cylinder Bushings

The summary of the reports indicates the tendency to get away from common gray iron castings for these important wearing surfaces. There are a number of tests of materials which hold considerable promise and which tests have not proceeded sufficiently far to justify extensive installation.

One road reported on a material with the trade name Meehanite, which material is susceptible to heat treatment, and in the heat-treated condition has superior physical qualities as compared with ordinary gray iron. The tests of these bushings in the heat-treated state have indicated possibilities of satisfactorily using this material for bushings.

The use of sectional piston packing was reported by all roads except two and has been adopted as standard on many of the larger roads representing the majority of the locomotives from the roads reporting. The use of sectional valve rings is less general than the use of sectional piston rings. Reports show approximately fifteen per cent as many locomotives equipped with sectional valve rings as were equipped with sectional piston rings, however, use has become quite general as evidenced by the fact that twenty-two of the thirty-four roads reporting reported the use of sectional valve rings on certain locomotives, or they have standardized on the sectional valve rings or have extensive tests under way.

Invariably the reports indicated that there was considerably increased life from the sectional valve and piston rings, ranging from 100 to 250 per cent.

Methods of Lubricating Engine-Truck, Driver and Trailer Hubs

The reports indicate that the necessity of ample lubrication of these parts is appreciated and that some method other than the hand oiler is desirable. This is evidenced by the fact that practically all railroads replying indicated one of many various methods, ranging from the hand oiler in the hands of the engineer, crater compound and soft grease applied at engine terminals with a paddle, and to the use of valve oil applied through force-feed lubricators.

A number of the roads reported on the use of soft grease applied by means of a pressure gun and special fittings to cavities drilled through the hub of the wheel, and they indicated that this arrangement is quite satisfactory.

With the advent of the various types of dividers or splitters now available for use with force-feed lubricators, many locomotives of recent design, as well as heavy locomotives as they pass through the shop, are being equipped with these dividers which insure a regular distribution of engine oil, or equivalent oil, to the various hub-liner faces as well as to other bearings, and since the regularity of the application of lubricant is greatly to be desired it appears to your committee that any of the various methods of accomplishing this through the use of force-feed lubricators is deserving of serious consideration, and especially so on locomotives on long engine runs. Such applications properly maintained should pay good dividends in trouble-free performance, elimination of servicing enroute as well as reduction of lateral wear.

Method of Lubricating Guides

The replies received indicate the necessity for improved lubrication to locomotive guides. While the syphon oil cup, or oil cups equipped with a wick feed largely predominate on the older types of locomotive, the modern locomotives and locomotives under heavy duty in high-speed service are being rapidly equipped with force-feed lubrication. Apparently many of these applications have been made in an effort to use existing lubricators since a number of the roads are using valve oil through dividers to lubricate the guides. Other locomotives that are equipped with a second engine lubricator are using engine oil

on the guides as well as other wearing parts of the locomotive. However, practically all of the roads indicated that the force-feed method is most efficient and satisfactory.

Method of Lubricating Shoes and Wedges

Many locomotives have no provision for lubricating shoes and wedges other than hand oiling usually through waste pockets in the top of the box which are saturated with oil with the hope it will find its way through various passages and grooves to the face of shoes and wedges. The deficiency in this system and the principal objection to it is the fact that its success is dependent first, upon terminal forces to maintain the waste pads and, second, upon the attention given by the enginemen at initial terminal and enroute.

A large number of locomotives have been equipped with grease cavities to which soft grease is applied by the use of a pressure gun. This method is generally considered superior to hand oiling as evidenced by the fact that at least ten roads out of the thirty-four have indicated this system as their preference over hand oiling. There are objections to the use of soft grease; first, due to the tendency of terminal forces to apply an excessive amount and, second, the tendency on the part of the grease to increase its flow, sometimes in excessive amounts, after driving boxes reach a normal running temperature.

The extension of lubrication to these parts by means of force-feed lubricators through the use of dividers is increasing. On the majority of locomotives of recent construction, and particularly those with roller bearings, the mechanical lubricator has been generally adopted.

Specifications of Diesel Crank Case Oil

There is considerable range in the specifications of crank-case oil used by those roads operating Diesel-powered high-speed main-line trains, the majority using such an oil approximately of the specifications SAE 50. It is evident that many of them purchase oil for this purpose by brand.

Those roads operating locomotives in switching service also use a wide range of crank-case oil, but generally an oil somewhat heavier than SAE 50, with a tendency to vary the pour point between summer and winter, depending upon the territory in which the operation is carried on.

The practice as to mileage between oil changes is as varied as the source of supply. In road service the railroads reported oil changes ranging from 2,500 miles to 10,000 miles, and in yard service from three months to 25,000 miles. This wide variation may be explained in part through the use of continuous type filters located upon the unit in some cases, and in other cases upon the nature of the service performed.

In view of the claims of the damaging effect of acidity in crank case oil, the committee's questionnaire was designed to develop any troubles from this source and the method of correcting same. The thirteen roads operating Diesel engines advised they had experienced no difficulties traceable to acidity in crank-case oil. One or more roads advised they had arranged their oil changes in order to avoid development of acidity and apparently had been successful.

Lubrication of Armature Bearings

Armature bearings seem to be quite distinctly divided, with roller or ball bearing predominating on locomotives in road service, and waste-packed friction bearings on locomotives in yard service, although a number of roads reported roller or ball bearings on switch engines.

The servicing period for the ball or roller bearings vary with the service requirements. In general the grease cavities are filled to approximately half their capacity when the unit is placed in service; thereafter. the pinion end is lubricated with from four to eight ounces of grease at intervals of from 4,500 to 23,000 miles. The armature end is lubricated with from four to twenty-four ounces of grease at intervals of approximately 20,000 miles. In general a good grade of ball-bearing grease is used, usually a brand recommended by the bearing manufacturer.

In switching service invariably long-strand wool waste is used for packing, and the grade of lubricant used varies from SAE 30 to a mixture of fifty per cent car oil and fifty per cent crank-case oil and various oils apparently purchased by brand.

Method of Lubricating Axle-Cap Bearings

Axle cap bearings are uniformly lubricated by the use of long-strand wool-waste wick held securely against the journal by means of balls of waste and in many cases additional pressure is applied against the wick by means of a loaded steel plate to insure packing against jarring or shaking away from the journal. This practice is in accord with the various motor manufacturers' recommendations.

Two roads reported having experimented with force-feed lubrication to the oiled wick to insure ample lubrication at all times. There is no evidence that this practice is being extended. The greatest variation in the practice of lubricating axle cap bearings appears to be in the service period. Some inspect and reservice each trip and others on thirty days' inspection.

That the type of bearing and service obtained from the method of lubricating axle cap bearings has been entirely satisfactory can be based upon the replies of twelve of the thirteen roads reporting on operation of Diesel units to the effect that they had experienced no difficulty and had no recommendations for improvements; the remaining road failed to answer this question.

The report was signed by E. L. Johnson (chairman), engineer of tests, New York Central; H. P. Allstrand, principal assistant superintendent motive power, Chicago & North Western; J. R. Jackson, engineer of tests, Missouri Pacific; P. Maddox, superintendent car department, Chesapeake & Ohio; and A. J. Pichetto, general air brake engineer, Illinois Central.

Discussion

The first speaker during the discussion suggested the idea of ribs being welded in the car journal boxes to keep the waste down in the lower portion of the box, and requested that other roads try this arrangement. The next speaker stated that pressure grease lubrication of center plates had not been found entirely satisfactory, but that oil, using the same piping arrangement as with grease and with a suitable seal, was providing satisfactory lubrication.

Two other speakers, discussing the lubrication of Diesel engines, stressed the importance of maintaining a clean air supply to the engine by the use of suitable filters and the last speaker made the comment that the successful lubrication of Diesel engines depends, to a great extent, upon filters and cooling equipment. On the road that he represents the practice has been adopted of taking weekly samples of oil from the crank cases of all Diesel engines and sending them to the laboratory for analysis. It has been found that the viscosity and precipitation number are the most important elements in the analysis, and that, as a result of this practice, it has now become possible, on one class of Diesel-electric locomotives, to limit the oil changes to one each twelve months, subject, however, to the weekly laboratory analysis.

(*The report was accepted.*)

Report of Arbitration Committee

With the approval of the Operating-Transportation Division, no extension beyond January 1, 1940, is recommended for requirement in Paragraph (a-6) of Rule 3, prohibiting acceptance of cars in interchange bearing advertisements of any shipper, consignee or product. The wording of this paragraph has also been revised to harmonize with Operating-Transportation Circular No. T-55 dated April 19, 1939, making an exception of special cars of Mechanical Designation "L" and tank cars of Mechanical Designation "T."

The requirement in Paragraph (r-3) of Rule 3 which provides that hatch covers be secured with hinges on refrigerator cars, has been in the rules since August 1, 1930. No requests for extension of effective date beyond January 1, 1940, have been received. The committee feels that sufficient time has elapsed to permit compliance and that, in the interest of safety, no further extension of effective date is justified.

In accordance with proviso attached to approval of extension of effective date of Paragraph (t-17) of Rule 3 to August 1, 1939, specifying that plugs in heads of tank cars must be of solid type in order to comply with I. C. C. Specification No. 103, no further extension is recommended.

As result of complaints from various railroads and railroad clubs as to excessive defect carding for minor damage, including submission of hundreds of defect cards which had been outlawed without repairs having been made, an investigation and field study has been conducted under the direction of the committee. A revision of Rule 4 is recommended which it is felt will eliminate much of the excessive carding for minor damage, clarify the rule and set up more definite limits for the guidance of car inspectors.

A new interpretation is added to Rule 4 to provide that carding company be granted the option of participating in joint inspection on cars damaged extensively by fire or flood and sent home bearing defect cards containing general statement of damage without specifying detail defective parts.

Upon recommendation by the Committee on Couplers and Draft Gears and with the concurrence of the Committee on Car Construction, Rule 20 is revised to provide for proper alignment of couplers and draft gears in connection with adjustment of coupler height.

The permissible re-light-weighing period is eliminated from Rule 30. Investigation developed that many foreign cars were being shopped for re-weighing immediately upon expiration of the 24-month permissible period. It is felt car owner should have the opportunity to re-weigh his own equipment prior to expiration of the 30-month period. As result of recommendation by your committee to the Operating-Transportation Division, this change has been submitted to letter ballot of that Division's members and approved.

Interpretation No. 9 to Rule 32 is modified to eliminate defect carding for minor damage caused by pulling with hook and cable.

The matter of establishing separate rates for and dates from which depreciation is to be computed for tanks, underframes and trucks of tank cars, for settlement purposes for destroyed cars, has been investigated by a joint subcommittee of representatives of the Arbitration and Tank Car Committees. A modification of Rule 112 is recommended to provide for separate depreciation of tanks of tank cars from date originally built, with no change in depreciation rates or limits, which it is felt affords a more equitable settlement basis. Provision is also incorporated to permit car owner to secure return of serviceable tanks from such cars, if desired.

The committee does not feel that any of the modifications included in its report necessitate submission to letter ballot.

All recommendations for changes in the Rules of Interchange submitted by members, railroad clubs, private car owners, etc., have been carefully considered by the committee and, where approved, changes have been recommended.

Attention is again directed to the fact that the Arbitration Committee will not consider questions under the Rules of Interchange unless submitted in the form of Arbitration Cases as per Rule 123.

Freight-Car Rule 3

The committee recommends that effective dates for various requirements in the present rule, as listed below, now set at January 1, 1940, be extended to January 1, 1941:

Section (b), Paragraph (8)—Bottom rod and brake beam safety supports.

Section (b), Paragraph (9)—Braking power.

Section (b), Paragraph (10)—Brake shoes.

Section (c), Paragraph (11)—Couplers having 5-in. by 5-in. shanks.

Section (j), Paragraph (2)—Journal boxes, repacking of.

Section (t), Paragraph (3)—Welded side frames having T- or L-section compression or tension members.

Section (u), Paragraph (4)—Class E-3 cars not to be accepted from owners.

Also, that the effective date of Paragraph (7) of Section (b) of this rule, having reference to metal badge plate showing dimensions of brake levers standard to car, now set at January 1, 1940, be extended to January 1, 1942.

Reason: The present situation justifies these extensions.

The committee recommends that no further extension beyond August 1, 1939, be granted for effective date of requirement contained in Paragraph (17) of Section (t) of this rule, requiring that plugs in tanks of tank cars must be of the solid type, and that the wording be modified and revision included in the next supplement, as follows:

Proposed Form: (t-17) Tank cars (empty or loaded): Effective August 1, 1939, plugs *in heads of* tank cars must be of the solid type, etc.

Reason: Extension to present effective date was approved with proviso that no further extension would be granted due to the fact the provision was incorporated in the 1938 Code as a safety measure to comply with I. C. C. Specification No. 103. Requirement modified to apply only to plugs in heads of tank cars, as recommended by the Committee on Tank Cars.

The committee recommends that the last two sentences in Paragraph (4) of Section (a) of this rule be modified and revision included in the next supplement, to require reports to the A. A. R. by car owners semi-annually instead of quarterly.

Reason: It has been agreed that semi-annual reports will suffice for the purpose. Notice of change in this requirement was transmitted to all car owners on April 8, 1939, and no request was submitted for data covering the first quarter of 1939.

The committee recommends that Paragraph (3) of Section (s) of this rule be modified, effective August 1, 1939, as follows:

Proposed Form: (s-3) Stenciling: Date built new, month and year, or badge plate giving this information, required on all cars. Date rebuilt, in addition to date built new, month and year, or badge plate giving this information, required on all cars rebuilt on or after July 1, 1928. From owners: *In event tank and underframe of tank car are built at different times each must bear distinctive dates, the date on underframe to be date car was originally built.*

Reason: To harmonize with change in Paragraph A-5 of Rule 112.

The committee recommends that Paragraph (3) of Section (u) of this rule be modified as follows:

Proposed Form: (u-3) Underframe, etc.: No car of all-wood underframe equipped with metal draft arms extending 24 inches or more beyond center line of body bolster, will be accepted. *In interchange.*

Reason: Definition of Class E-4 car will be eliminated from Rule 112. It is felt sufficient time has elapsed to make this provision a general interchange requirement.

Rule 4

The committee recommends that Section (a) of this rule be modified and Interpretations Nos. 2 and 6 eliminated, as follows:

Proposed Form: Rule 4. (a) In the case of damage to a car for which the delivering line is responsible, such line must at the first available inspection point, attach defect card to cover. On cars extensively damaged which are forwarded home for repairs, the defect card, in addition to the defects noted, shall bear notation "Home for repairs." *This notation shall be applied only by the company issuing the defect card. No alterations may be made to defect card except by company issuing same or in cases of partial repairs as outlined in Rule 5. Defect cards cannot be repudiated.* If only a portion of the unfair usage damage is repaired, defect card *for the remainder of such damage* must be applied *prior to release of car.*

Reason: It is immaterial whether the partial repairs are made in shop or elsewhere and it should be clear that only the unrepaired portion must be carded. Last sentence modified and transferred to Paragraph (b-2) which deals with carding in interchange.

The committee recommends that Section (b) of this rule be modified as follows:

Proposed Form: (b) (1) Slight *unfair usage* damage that of itself does not require repairs *to make car serviceable is not cardable, whether or not associated with other cardable damage. Items damaged to a lesser extent than specified in Sections (c) to (h), inclusive, are considered as slight damage within the meaning of this paragraph.*

(2) *If cars are offered in interchange with damage other than referred to in Paragraph (b-1), on which there is conclusive evidence of unfair usage, the receiving line shall require that defect card be attached to car, per Rules 2 and 14. Damage to or beyond extent specified in Sections (c) to (h), inclusive, will be classified as unfair usage for which defect card shall be issued in interchange.*

Reason: It is felt slight damage, whether caused by fair or unfair usage, which does not require repairs to make car serviceable, should remain the responsibility of car owner regardless of any other cardable damage on car: To clarify the intent and set up definite limits for the guidance of car inspectors regardless of cause of damage.

The committee recommends that Section (c) of this rule be modified as follows:

Proposed Form: (c) House Cars, All-Steel and Outside Steel Frame:

(1) Metal posts, metal braces and metal sheets: Cut through the thickness of the metal. *Post and brace* flanges only, cut through, will not be cardable.

(2) *Metal posts, metal braces and metal sheets*: Bent inwardly 1½ inches or more. Bulb portion only of pressed-steel parts, or flanges only *of structural shapes,* when bent, *regardless of extent,* will not be cardable except where necessary to repair under conditions referred to in Paragraph (3).

(3) *Metal posts, metal braces and metal sheets*: Bent inwardly less than 1½ inches, *when* necessary to repair for proper operation of door, or to comply with Safety Appliance requirements, or to restore alignment of bolt holes, rivet holes, or joints for welding.

Reason: To clarify the intent and harmonize with change in Paragraph (b-1). Metal slats omitted account practically none in use on house cars.

The committee recommends that a new sentence be added to first note following Section (d) of this rule and Interpretation No. 4 eliminated, as follows:

Proposed Form: Note.—It is understood that adjoining raked sheathing if not split or broken will not be cardable unless raked into tongue, except that on refrigerator cars sheathing boards raked to bottom of bead but not into tongue will also be cardable if they adjoin (in consecutive order) the board raked into tongue, broken or split. *Sheathing damaged due to use of bar for closing side door is not cardable.*

Reason: To eliminate Interpretation No. 4.

The committee recommends that Section (f) of this rule be modified as follows:

Proposed Form: (f) Open-Top Cars.

(1) Metal posts, metal stakes, metal braces, metal top chord angles, or their substitutes: Bent inwardly *four* inches or more. Bulb portion only of pressed steel parts, *or* flanges only *of structural shapes,* when bent, *regardless of extent,* will not be cardable except where necessary to repair under conditions referred to in Paragraph (2).

(2) Metal posts, metal stakes, metal braces, metal top chord angles, or their substitutes: Bent inwardly less than *four* inches, but necessary to repair for proper operation of door or gate, or to comply with Safety Appliance requirements, or to restore alignment of bolt holes, rivet holes, or joints for welding.

(3) Metal *side and end* sheets: *Holes* through the thickness of the metal to an extent exceeding three inches *measured in any direction, except when due to corrosion.*

(4) (No change.)

(5) *Metal top chord angles or their substitutes*: *Holes exceeding 1½ inches measured in any direction.*

(6) *Flat car floors; metal or wood*: *Holes cut, exceeding three inches in any direction,* except wood floors having holes not exceeding 3 by 12 inches each (latter dimension lengthwise of car) for center pin of pivoted load bolsters.

Note.—Holes in cars due to change in construction, or parts cut out to provide clearance for safety appliances, are not cardable.

Reason: To eliminate excessive defect carding for minor damage.

The committee recommends that Section (g) of this rule be modified as follows:

Proposed Form: (g) (1) All cars: Metal and sill, *damaged in unfair usage, when removal from car is necessary for any repairs to car.*

(2) All cars: Metal side sills, extending from bolster to end sill only, if flange or web is bent in excess of *2½* inches.

(3) (No change.)

Reason: To clarify the intent and eliminate excess wording. Dimension for bent side sill modified to *2½* inches, to harmonize with Rule 44.

The committee recommends that first paragraph of Section (h) of this rule be modified by omitting reference to *present* head-block anchorage.

Reason: To clarify the intent, as tank cars having head-block anchorage are no longer permitted in interchange service.

The committee recommends that third paragraph of Section (h) of this rule be eliminated.

Reason: Cars with defective safety appliances cannot be interchanged under Rule 2. This requirement relocated in Rule 33.

The committee recommends that a new note be added to Section (1) of this rule and Interpretation No. 5 eliminated, as follows:

Proposed Form: (1) *Note.—All associated defects should preferably be recorded on information card. However, if this is not done, the existence of such additional defects shall be established by joint inspection certificate executed at home shop as outlined in Section (k) of this rule within 90 days after first receipt of car by owner. In the event Rule 44 damage cannot be established as owner's defects, defect card shall be issued by the company issuing the information card for all associated defects as well as the Rule 44 damage.*

Reason: For better reference.

The committee recommends that a new interpretation be added to this rule, to become effective August 1, 1939, to read as follows:

Q.—Where defect cards read "Car in flood" or "Superstructure damaged by fire," or other similar general statement of damage without specifying defective parts, whether or not containing notation "Home for repairs," is car owner required to have joint inspection made and apply for detailed defect cards per Section (k)?

A.—In such cases where whole or part of superstructure is involved through general statement of damage, car owner must accord railroad issuing defect card the opportunity of participating in joint inspection, whether or not a chief interchange inspector is employed in such inspection. If railroad issuing such defect card fails within 15 days from date of notification to avail itself of the opportunity of making joint inspection, then the joint inspection shall proceed in the manner prescribed in Section (k).

Reason: It is considered the provisions of Section (k) as to joint inspection can reasonably be extended to cars extensively damaged in flood or by fire and that carding company should have the option of participating if desired.

Rule 9

The committee recommends that third item in this rule with respect to information that must be specified on billing repair cards in connection with "Periodic Repacking of Journal Boxes," be modified as follows:

Proposed Form: Purpose for which car was shopped, *if repacked prior to expiration of 15 months.*

Reason: This information is unnecessary on cars repacked after the 15-months limit has expired.

The committee recommends that sixth item in this rule be modified as follows:

Proposed Form: Brake shoe keys, applied: 1934 A. A. R. Standard, *or the symbol* "K-34," must be shown to justify charge.

Reason: To clarify the intent.

Rule 17

The committee recommends that last column opposite Item No. 5 in the brake-beam substitution table appearing in Section (e) of this rule be modified, by the addition of a last clause, to read as follows:

Yes. Issue defect card for labor and material *whether or not No. 2-plus beam is standard to car.*

Reason: To clarify the intent and eliminate confliction with No. 5.

Rule 20

The committee recommends that second paragraph of this rule be modified as new Paragraphs (b) and (c), a new last Paragraph (f) and new Figures 1, 2, 3 and 4 added and interpretation eliminated, effective August 1, 1939, as follows:

Proposed Form: (*b*) *When adjusting coupler heights under*

*the provisions of Paragraph (a), the coupler should first be placed in proper alignment with draft gear. Shim as shown in Figures 1, 2, 3 or 4 [The drawings referred to are not included—*EDITOR*] of ¼-inch thickness or more as required, may be applied for this purpose. If shim less than ¼-inch thickness is required, re-alignment is unnecessary.*

(c) After coupler has been placed in proper alignment by shimming carrier, if its height is not at least ½ in. in excess of minimum dimensions specified in Paragraph (e), further adjustment should be made at the truck springs, center plates or journal boxes.

(f) When couplers or draft gears are removed, replaced or renewed for or on account of repairs, and coupler height is within prescribed limits, the couplers and draft gears should be properly aligned as provided in Paragraph (b).

Reason: To provide for proper alignment of couplers and draft gears in connection with adjustment of coupler height, as recommended by the Committee on Couplers and Draft Gears and with the concurrence of the Committee on Car Construction.

Rule 23

The committee recommends that Section (g) of this rule be modified as follows:

Proposed Form: (g) When truck side frames, bolsters and knuckle-tail back wall of coupler heads are welded, the following record must be legibly stamped on the weld *or immediately adjacent thereto* by at least ⅜-in. steel stencils, in the following form:

(No other change.)

Reason: In some cases it is impractical to apply the stencil on the weld and stamping same immediately adjacent to the weld should suffice.

Rule 30

The committee recommends that Paragraph (1) of Section (B) of this rule be modified effective August 1, 1939, by eliminating the "wood" type of car and last column reading "Subsequent reweighing permissible after 24 months" be changed to 30 months.

Reason: To harmonize with change in Car Service Rule 11, as approved by letter ballot of the Operating-Transportation Division.

Rule 31

The committee recommends that Paragraph (b) of this rule be modified, effective August 1, 1939, as follows:

Proposed Form: (b) Where weight of car is changed 300 lb. or more (for refrigerator cars 500 lb. or more) account repairs of delivering company's defects, the expense of relight-weighing and re-marking will be charged to party responsible for such defects, unless *car is due for re-weighing per Paragraph (1), Section (B) of Rule 30.*

Reason: To harmonize with change in Rule 30.

Rule 32

The committee recommends that caption preceding this rule be modified as follows:

Proposed Form: Parts of Cars Which Justify Repairs If Owners Are Responsible, or Repairs or Carding If Delivering Company Is Responsible, *Except As Otherwise Provided For In Rule 4.*

Reason: To avoid confliction with Rule 4.

The committee recommends that Section (6) of this rule be modified as follows:

Proposed Form: (6) Removing parts or burning out parts of car to facilitate loading, unloading or for other purposes.

Reason: Account change in Rule 4 which covers.

The committee recommends that Interpretation No. 9 to this rule be modified, effective August 1, 1939, as follows:

Proposed Form: Inter. (9) Q.—Who is responsible for damage to car caused by pulling with hook and cable?

A.—Car owner, except where damage is such as to prevent side bearing from functioning or where body bolster or crosstie is pulled entirely away from side sill.

Reason: To eliminate excessive defect carding for minor damage.

Rule 33

The committee recommends that Paragraph (3) of Section (b) of this rule be modified as follows:

Proposed Form: (3) Safety appliances on tank cars where damaged under any of the provisions of Rule 32, *including safety railings, handholds, sill steps, ladder treads, and their brackets or supports, also running board supports when bent so that safety appliances are beyond clearance limits prescribed by I. C. C. Safety Appliance Acts.*

Reason: Transferred from Rule 4.

Rule 64

The committee recommends that second paragraph of this rule be modified as follows:

Proposed Form: No charge shall be made for application of separate common nuts unless such nuts are fully tightened, and, where applied to journal-box bolts, column bolts, brake-hanger bolts, carrier-iron bolts, *or coupler and draft-gear support bolts,* such common nuts must be secured with nut lock or lock nut.

Reason: As a safety measure.

Rule 98

The committee recommends that reference to Rule 73-A and 83 be eliminated from Paragraph (4) of Section (c) of this rule.

Reason: To eliminate confusion in billing.

The committee recommends the addition of a new first note following Section (g) of this rule, and that present note be relocated as a new second note and modified by addition of new last clause, to read as follows:

Note 1.—Gage readings for multiple-wear wrought-steel wheels removed and applied, when the "after turning" measurements are predetermined by Standard wrought-steel wheel gage, must be reported at top of wheel-and-axle billing repair cards as per following example:

	(1)	(2)	(3)
(One wheel)	*2¼ in. — (minus)*	*¾ in. — (minus)*	*9/16 in.*
(Mate wheel)	*2 3/16 in. — (minus)*	*¾ in. — (minus)*	*3/16 in.*

to indicate for each wheel (1) tread thickness over all, (2) amount of metal between measuring point and condemning line and (3) amount of metal to be turned off as indicated by wrought-steel wheel-gage finger to produce full flange contour.

Note 2.—In the predetermination of service metal on wrought-steel wheels by use of the standard wrought-steel wheel gage, when neither wheel is scrap, the amount of metal required to be turned off the wheel suffering the greater amount of loss should apply equally to the mate wheel. When recording service metal of wrought-steel wheels on billing repair cards, the amount of service metal before and after turning, as indicated by steel-wheel gage, shall be shown for each wheel, *with the understanding that the amount of service metal after turning shall be determined by deducting the greater amount of loss on either wheel from the amount of service metal on each wheel before turning.*

Reason: To clarify the intent. It is also felt car owner is entitled to the gage readings to permit check of charges and credits.

The committee also recommends that the Wheels and Axles Billing Repair Card forms shown on pages 264 and 265 be modified to provide "Before Turning" and "After Turning" captions for wheels applied as well as removed.

Reason: Account change in Section (g) of Rule 98.

Rule 102

The committee recommends that last paragraph of this rule be modified as follows:

Proposed Form: In computing charges for paint, bolts, *nails,* nuts and forgings, if fractional weight of each entry on billing repair card is less than one half pound, it must be dropped; if one-half pound or more, charge the entire pound.

Reason: It is felt no charge should be made for this small amount of material.

Rule 111

The committee recommends that Item (8) of Paragraph (b) of Section 15 of this rule be modified as follows:

Proposed Form: (8) Vent protector. (Original application *may be charged only when periodic cleaning is performed.*)

Reason: Vent protectors should be applied in all cases when brakes receive periodic attention.

Rule 112

The committee recommends that Paragraph 5 of Section A of this rule be modified, effective August 1, 1939, as follows:

Proposed Form: (5) Age of car shall be determined by subtracting year and month in which car was originally built, or rebuilt, from year and month in which car was destroyed, which will give the life in years and months. No fractional part of a month shall be considered. The age of trucks shall be the same as that of the car body. *Where new or second-hand tank is applied to a tank car subsequent to original date car was built, depreciation on such tank shall be computed from date tank was built new, and depreciation on remainder of car shall be computed from date car was originally built.*

Reason: To afford equitable compensation in settlement for destroyed tank cars.

The committee recommends that reference to the Class E-4 type of car be eliminated from table of per pound prices in Section B of this rule, and note following this table modified, as follows:

Proposed Form: Note.—Cars with continuous metal draft sills of not less than 18 lb. per foot per member, without cover plates, where such continuous metal draft members are suitably tied to body bolster, are equivalent to *Class E-3* for settlement purposes.

Also, that similar modification be made in Paragraph (4) and note following at bottom of page 239, and that all reference to the Class E-4 car be eliminated from Sections C, F, G and K of this rule.

Reason: Class E-4 cars have not been permitted in interchange from owners since January 1, 1937.

The committee recommends that first sentence of Section J of this rule be modified to include tanks of tank cars, effective August 1, 1939, to read as follows:

Section J.—Return of Serviceable Material to Car Owner:

1. When car owner is requested to furnish settlement value of a car under this rule, such owner when furnishing settlement value may instruct the handling line to return cast-steel truck side frames, metal truck and metal body bolsters, metal draft arms, friction draft gears, cast-steel yokes, metal ends and auto loading devices; also *tanks,* special castings and valves of tank cars.

Reason: To permit owner opportunity to recover such tanks, if desired.

Passenger-Car Rule 4

The committee recommends that the effective date of second paragraph of this rule, with reference to equipping all-steel or steel under-frame cars with cardboards or suitable receptacle for the accommodation of defect and joint-evidence cards, now set at January 1, 1940, be extended to January 1, 1941.

Reason: The present situation justifies this extension.

Passenger-Car Rule 8

The committee recommends that a new last sentence be added to Section (h) of this rule, which specifies delivering-line defects, as follows:

Proposed Form: (h) Burst or broken steam pipes and fittings, damaged steam valves, traps and parts of same (inside of car), when due to freezing, on cars equipped with a combined steam-heat cut-out and drain valve, also on cars equipped with hot-water system of heating, except when accompanied by porter furnished by car owner, who fails to bring to the attention of the handling line conditions that would cause any of the parts above mentioned to freeze. *The same responsibility applies to burst or broken water tanks, pipes and fittings (inside of car), when due to freezing.*

Reason: Handling line should properly protect cars from damage by freezing.

Passenger-Car Rule 13

The committee recommends that a new seventh item be added to Section (b) of this rule (no labor or material charge permitted), effective August 1, 1939, as follows:

Proposed Form: *Lubricating and adjusting manually operated truck clasp-brake slack adjusters.*

Reason: It is felt no charge should be permitted for this operation.

The report was signed by W. H. Flynn (chairman), general superintendent motive power and rolling stock, New York Central; J. P. Morris (vice-chairman), mechanical superintendent, Atchison, Topeka & Santa Fe; R. G. Bennett, general superintendent motive power, Pennsylvania; A. E. Smith, vice-president, Union Tank Car Company; J. A. Deppe, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific; L. Richardson, mechanical assistant to vice-president and general manager, Boston & Maine; G. E. McCoy, assistant general superintendent car equipment, Canadian National, and M. F. Covert, general superintendent of equipment, General American Transportation Corporation.

(*The report was adopted.*)

Report on Couplers And Draft Gears

Approved Draft Gears

During the past year a certificate of approval was issued for the Waugh-Gould Type 410 draft gear, bringing the total number of approved gears to eleven which are made by six different manufacturers. One of these manufacturers also has made application for approval of another type of gear. Tests have been completed and the report is being prepared.

The Waugh-Gould Type 410 gear is the first one that has received conditional approval. This signifies that the only information we have about it is based on the laboratory test, and that its performance in service will be watched until it is known that the conditional restrictions can be safely removed and a certificate of approval be granted, or that a certificate should be denied. It has been decided that conditionally approved gears should receive the same protection in interchange that is accorded approved gears, and the Interchange Rules have been so amended.

Because of indications that the manufacturers of draft gears will continue to offer new types for approval, consideration has been given to the problem of limiting the number of approved gears. It has been decided that a gear can remain conditionally approved for a period of not more than two years. At the end of this time the gear must either be withdrawn by the manufacturer or advanced to fully approved status and his former approved gear for the same pocket withdrawn.

Check Tests on Approved Draft Gears

During the year the laboratory work in connection with check tests of two each of seven different types of approved draft gears has been completed. These check tests disclosed some serious failures to maintain the standards of quality that were shown by original approval tests. Inasmuch as there is some evidence of the existence of extenuating circumstances in certain cases, the subcommittee believes it advisable to withhold publication of the results until the manufacturers involved have had full opportunity to examine the test specimens and to offer any explanations they may have to account for the discrepancies found. In any case where a satisfactory explanation cannot be

given and adequate corrective measures have not been taken, the manufacturer will be required to file an application for a complete retest. One thing these check tests have emphasized is the necessity of making them more frequently in the future.

Draft-Gear Attachments and Installations

During the year the subcommittee has worked with the Car Construction Committee to improve the draft-gear attachment situation and has secured adoption of a revised location of the draft-gear support for A. A. R. standard cars to prevent the rear of the coupler yoke from being elevated when the draft gear is closed in pull. Tolerances for standard draft-gear attachments were worked out and adopted to remedy trouble caused by couplers being tight in housings. The Arbitration Committee has reported trouble experienced from mutilation of car center sills because of the indiscriminate substitution of approved draft gears for each other. This is because all approved gears do not use the same carry irons and filler pieces. At one time consideration was given to the possibility of requiring all approved gears to be so constructed that they would use the same carry irons, etc., but after studying the details involved it was decided that the advantages to be gained by such a provision were very definitely outweighed by the disadvantages. A special subcommittee has been appointed to work with the Arbitration Committee to see if some other arrangement can be worked out to care for the situation.

Improvement in Draft Gears on Existing Cars

Interchange rules require approved draft gears on all cars built new after January 1, 1934; on all cars rebuilt after August 1, 1937, unless the underframe construction is such that an approved gear cannot be readily applied, in which case a gear acceptable to the sub-committee may be applied; and all new gears applied to any car after January 1, 1935, must be approved gears unless the pocket will not take an approved gear. These regulations will eventually result in there being only approved draft gears in service. The length of the transition period, in which we now are, will depend upon several factors the trend of which it is difficult to anticipate. Economic considerations prevent the scrapping of large numbers of non-approved gears which still have useful life left, regardless of the desirability of getting rid of such gears. In some cases economic necessity dictates that non-approved draft gears be repaired so as to further increase their useful life. It is hard to obtain agreement on the wisdom of doing this because of the different circumstances which attend individual cases. As an aid toward shortening the transition period, those non-approved gears, which it is most desirable to get rid of, have been classified as obsolete, and the incentive for maintaining them greatly reduced by permitting them to be charged for only on a scrap basis.

The policy has been pursued of giving full consideration to the wishes of both the manufacturer and the user before classifying any gear as obsolete, but the point has been reached where some definite measurement of obsolescence is needed. With this object in view, during the past year sub-committees of the Price Committee, the Arbitration Committee and the Coupler and Draft Gear Committee met in joint conference and recommended that any repaired non-approved draft gear that did not show at least 50 per cent of the required capacity for approved gears, when tested in the Association's laboratory, should be classified as obsolete. This recommendation has been approved by all of the committees involved, and the Draft Gear Sub-Committee is now making arrangements to secure representative samples of the gears in question so that they can be tested at the laboratory.

The Cardwell Type B gears and the Miner Types A-1 and A-IX have been added to the list of obsolete gears effective January 1, 1939. Agreement to this was secured without the necessity of making tests. There evidently is some misunderstanding of what the classification of a gear as obsolete means. When a gear is placed in the obsolete classification it does not mean that the owner must replace all such gears with other gears at the first opportunity.

On the contrary, under present rules, he can repair them and use them on his own cars without penalty. If, however, he applies these repaired gears to foreign cars he can charge only scrap price for them.

Another way in which the committee has endeavored to improve the draft-gear situation is by the proposal of a regulation which was adopted several years ago requiring car owners to inspect for draft-gear slack when cars were due for periodic cleaning of triple valves, and to drop the gears if more than 1½ in. free slack was found to exist. Complaint has been received of train accidents caused by pulling out coupler yokes, with accusation that cases of excessive free slack are being found.

This situation is being investigated further by the Committee and is being checked by the Mechanical Inspection Department of the A. A. R.

Draft Gears for Passenger Service

With the cooperation of a sub-committee of the Committee on Locomotive Construction, the Sub-Committee on Draft Gears has prepared during the year a proposed specification for draft gears for passenger car and locomotive tender service. This proposed specification is submitted herewith. It consists of a brief statement of the essential requirements together with a chart showing two compression and release curves, one for a gear designed for heavy service and one for a gear designed for light service. Submission is made at this time for the purpose of inviting comments and criticism. [Note: The chart is not included with this abstract—EDITOR.]

General Characteristics and Limitations

The general characteristics and limitations set forth in the proposed specification are as follows:

(a) For the first 1¼ in. at least, the travel of a passenger gear should consist of essentially free spring action to smooth out the pulsating drawbar pull of the locomotive, while the latter part of the travel should be resisted by friction, or equally effective means, with sufficient capacity to absorb occasional heavy impacts.

(b) The initial compression of the gear should be about 3,000 lb., and under a compression of 60,000 lb. the travel should be not less than 1⅜ in. nor more than 1¾ in.

(c) Depending upon conditions for individual applications, the total travel of the gear should be not less than 1¾ in. nor more than 2¾ in., with terminal resistance not to exceed 300,000 lb.

(d) The gear should be so designed that the spring resistance merges gradually into the friction resistance.

[The chairman of the Sub-Committee on Draft Gears is H. W. Faus.]

Swivel Butt Couplers

A member road during 1936 and 1937 built a group of hopper and gondola cars to which were applied A. A. R. Standard E Couplers in Grade B steel, A. A. R. vertical-plane swivel yokes in high-tensile steel and A. A. R. combination striking castings and front draft-gear stops in high-tensile steel. After some months of service it was noticed that these cars were showing a tendency to bulge the center sills in the region of the front draft-gear stop, right-hand side facing the car.

The Mechanical Committee of the Coupler Manufacturers was invited to cooperate with the railroad in making a study of the conditions that might be responsible for this damage. Several months of this study, including car-pushing tests, developed the following information:

(1) It is important that in the manufacture of vertical-plane swivel yokes the front and rear draft-gear bearing pads be made smooth and straight and at right angles with the longitudinal axis of the yoke;

(2) The vertical sides of the swivel yoke in high-tensile steel should be changed to increase the wearing area and reduce the lateral clearance between the front draft-gear stops to provide bearing areas to correspond with the Grade B steel design swivel yoke;

(3) The design of the front draft-gear stops in high-tensile steel should be improved by increasing the thickness of the vertical and horizontal ribs to provide wear surface equivalent to the Grade B steel design.

The changes recommended in the design of the vertical-plane swivel yoke in high-tensile steel to improve guiding between front draft lugs have been approved by the Coupler Committee.

The proposed changes in A. A. R. striking castings with in-

tegral draft lugs in high-tensile steel have been approved by the Coupler Committee and the matter referred to the Car Construction Committee for final action.

Type E Coupler Breakages

It has come to the attention of your Committee that there have been a number of breakages in the side wall of the coupler bodies due to the knuckle tail striking it. Examination of the broken coupler develops that this is due to the failure to open the knuckle when couplers are mated in classification yards. A number of breakages have also been found in the front face of the coupler and a review of these broken couplers shows it is the result of the coupler being struck a heavy blow on the guard arm by the opposing coupler. A thorough analysis of these two failures is being made in order to develop what, if any, changes in design are necessary.

Reclamation of Coupler Knuckles

It has been brought to the attention of the Coupler Committee that the 4⅞-in. nose-to-guard-arm spacing prescribed for reclaimed knuckles as outlined in the committee's report of 1932 is inconsistent with the gaging limits prescribed in Rule 18.

The committee wishes to explain that this closer gaging limit for reclaimed knuckles was prescribed in order that in the process of reclaiming the knuckle, the maximum advantage from a gaging standpoint might be obtained, and any variation from the 4⅞-in. spacing simply means so much loss in service from the nose-to-guard-arm gaging standpoint.

Safe-Lock Couplers

It was mentioned in last year's report that a modified design of coupler intended to prevent vertical slipovers and also provide a support for a coupler pulled from an adjacent car had been suggested to your committee.

This attachment on the standard coupler would increase the weight about 10 lb. and the price a proportionate amount. While there is some question about this type of coupler making coupling within the various ranges of coupler heights, the most serious objection and the one that condemns it from an interchange standpoint is that it cannot be coupled with the standard tight-lock couplers.

The Coupler Manufacturers and your committee have been endeavoring to develop some means by which these protection features might be provided on standard equipment, but so far the best development is represented in a casting that is located under the coupler head and supported by the guard arm on one side and the knuckle pin on the opposite side. This construction requires a longer knuckle pin with a nutted bottom end. The arrangement increases the coupler weight about 26 lb. and in lots of 1,000 would cost approximately $3.25 each including casting and special knuckle pin.

It is the opinion of the committee that the most practical and effective means for combating vertical slipovers is the more general use of 11-in. face knuckles in replacement of 9-in. face knuckles. The 11-in. face knuckles for Type E or D couplers cost only 30 cents more than the 9-in. face knuckle. It is the recommendation of the committee that the further production of 9-in. face knuckles for all types of couplers be discontinued and the patterns scrapped.

Specification for Type E Couplers in High-Tensile Steel

The increasing demand for Type E couplers in high-tensile steel is such that a specification covering this specialized product should be available for guidance of roads desiring high-tensile steel couplers.

Instead of preparing a separate specification covering Type E couplers in high-tensile steel, it was decided that Specification M-204, which covers the Type E coupler in Grade B steel, could be modified to include the couplers in high-tensile steel. The specification has been prepared along this line and has met the approval of the Committee on Specifications for Material, and the revised specification M-204 was appended to this report as Appendix B.

Tight-Lock Couplers

In the 1938 report, mention was made of the attention the Coupler Manufacturers were giving to certain details of refinement in the design and construction of tight-lock couplers. This study has been further advanced to the point where it now includes:

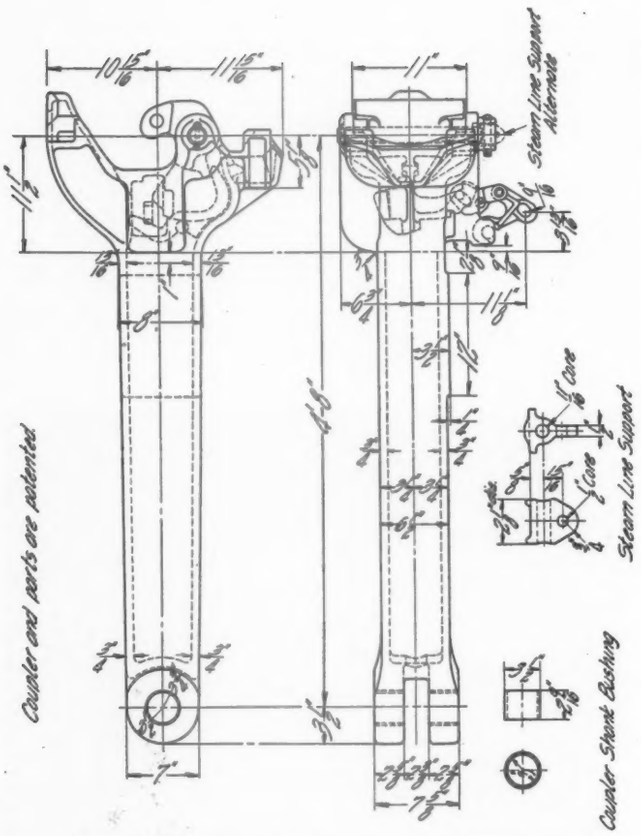
(1) An increase in the amount of surface of the contour to be machined.

(2) A revision of the location and size of the knuckle-pin hole in both bar and knuckle to provide for boring holes and the holes in the bar and knuckle to be concentric with each other.

(3) An improved anti-creep feature for the lock which definitely prevents the lock creeping in service and provides also for improved coupler operation.

(4) The gathering wing pocket on the knuckle side of coupler head has been revised to its original design as there no longer

A.A.R. tight-lock couplers with shanks under compression load of 1,000,000 lb.



A.A.R. tight-lock coupler for passenger equipment cars

exists the necessity for accommodating the tight-lock coupler to the control-slack coupler. This will provide more clearance for steam lines and improve the interlocking conditions.

These changes have been incorporated in the equipment and couplers manufactured subsequent to January 1, 1939, incorporate these improvements.

The principle of the tight-lock coupler is sufficiently different from the Standard E type coupler that it is desirable to provide instructions concerning the handling and maintenance of the tight-lock coupler.

These instructions are shown in Appendix A of the report and will also be issued as a separate circular.

Attention is called to these instructions in which are shown three types of coupler operating attachments that have been designed as satisfactory for use with the tight-lock coupler to suit the three different general types of car construction.

It is recommended that these three designs of uncoupling rods be submitted to letter ballot for adoption as recommended practice.

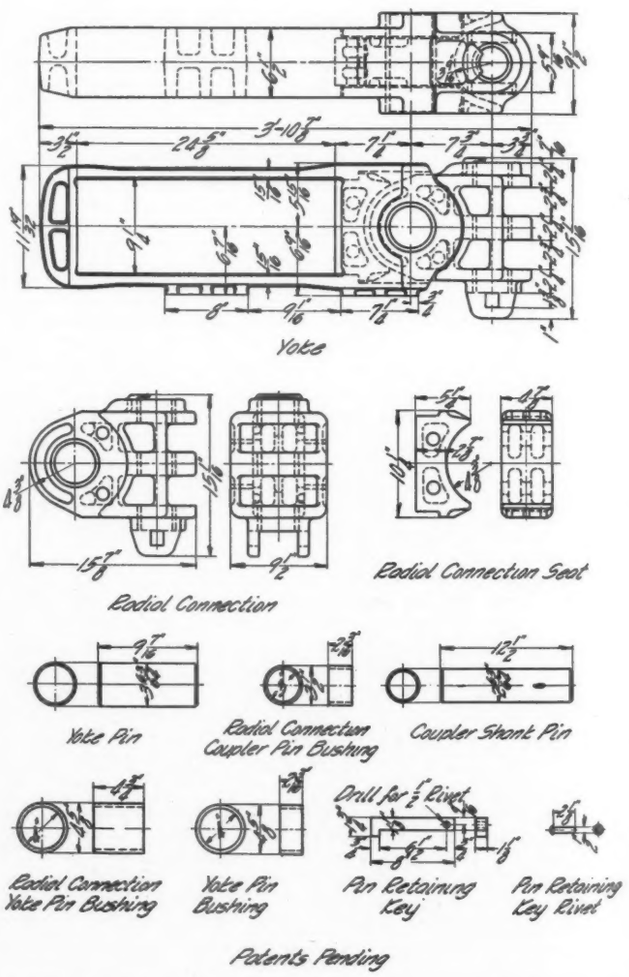
Laboratory Tests of A.A.R. Tight-Lock Coupler, Yoke and Radial Connection

The General Committee of the Mechanical Division, early this year appointed a special committee to develop specifications for design of new passenger equipment cars for interchange service. This special committee at a meeting held in Chicago on January 17, 1939, requested the Mechanical Committee of the Coupler Manufacturers to cooperate with the A.A.R. Committee on Couplers and Draft Gears in the development of a suitable design of shank and attachments for the A.A.R. tight-lock coupler. Further, that laboratory tests be made on the design agreed upon to indicate the strength of the arrangement in tension, compression and in vertical and lateral bending. The special committee suggested that the coupler shank be designed on the basis of 900,000 lb. yield strength as a column under compression. Also, that the anti-telescoping strength of two complete couplers coupled together be not less than 100,000 lb.

During joint meetings of the Mechanical Committee of the Coupler Manufacturers and the A.A.R. Committee on Couplers and Draft Gears held in Cleveland, on January 31 and February 1, 2, and 21, 1939, a design of shank, yoke and radial connection for the A.A.R. tight-lock coupler was agreed upon and a schedule of tests arranged to determine the strength of the unit under various loading conditions which might be encountered in service.

All castings for these tests were manufactured by the National Malleable and Steel Castings Company. All tests were conducted by the Mechanical Committee of the Coupler Manufacturers under the supervision of the A.A.R. Committee on Couplers and Draft Gears. The tests were started on March 15 and completed April 7, 1939.

Tests Numbers 1, 2, 4, 5 and 6 were conducted in a 1,000,000-lb. Olsen testing machine in the laboratory of the National Malleable and Steel Castings Company, Sharon, Pa. Test No. 3 was conducted in a 1,000,000-lb. Riehle testing machine in the laboratory of the American Steel Foundries, Alliance, Ohio. Test No. 7 was conducted in the Pennsylvania's 27,000-lb. drop test machine located at Altoona, Pa.



A.A.R. tight-lock coupler yoke and parts for passenger equipment cars

The results of these tests have not only exceeded by a considerable margin the requirements of the Passenger Car Specification for coupler strength, but have demonstrated that the results are consistent with the results of previous static tension and static compression tests on complete couplers made of high-tensile steel in the Standard "E" Coupler design.

The Committee recommends that this design of tight-lock coupler and attachments be submitted to the association for adoption as standard.

Secondhand Coupler Specifications

Item 3. Marking in the specification for secondhand couplers has been given several interpretations and as a result there has

been some confusion as to just what markings secondhand couplers reclaimed by welding should carry.

This item in the specifications for secondhand couplers has also been somewhat confused with the marking called for in Rule 23 where couplers are welded in the knuckle side wall.

In order to clarify Item 3 of the specifications it is recommended that the following change be made:

Proposed Form: Item 3. Marking—Secondhand couplers having body reclaimed by welding must be stamped with the railroad's initials, followed by the date reclaimed, in the location shown in Figure 1, page 5, of the pamphlet. (This stenciling on secondhand couplers should not be confused with the marking required by Rule 23, Section V(g) on couplers welded in the knuckle side wall.)

There is a correction to be made in the secondhand coupler specifications relating to the number identification of knuckle reclamation gages Process No. 2. Gage No. 25610-2 should be numbered 25610-1, correspondingly Gage 25610-1 should be changed to 25610-2.

The secondhand coupler specifications provide for guard arm distortion gage 25005—designed to measure guard arm distortion on No. 10 contours. As there appears to be a demand for a similar gage applicable to couplers having No. 10-A contours a new gage No. 25005-A has been designed. This gage is so constructed that one side is utilized for gaging the guard arm distortion on the No. 10 contour couplers while the opposite side applies to the No. 10-A contours. This gage is recommended for adoption as recommended practice.

Standard Catalogue Numbers for Couplers and Parts

The Mechanical Committee of the Coupler Manufacturers has been giving attention to the preparation of standard catalogue numbers that may be used by the several manufacturers for identifying parts of the Type D coupler, the Standard E coupler and tight lock coupler, including various attachments. The Committee has been advised that this work is now completed, and this standard system of identifying couplers and parts by the Coupler Manufacturers will become effective July 1, 1939. It is recommended that this information be included in an A. A. R. circular to be issued to the members.

Appendix A—A.A.R. Tight-Lock Coupler Instructions for Handling and Maintenance

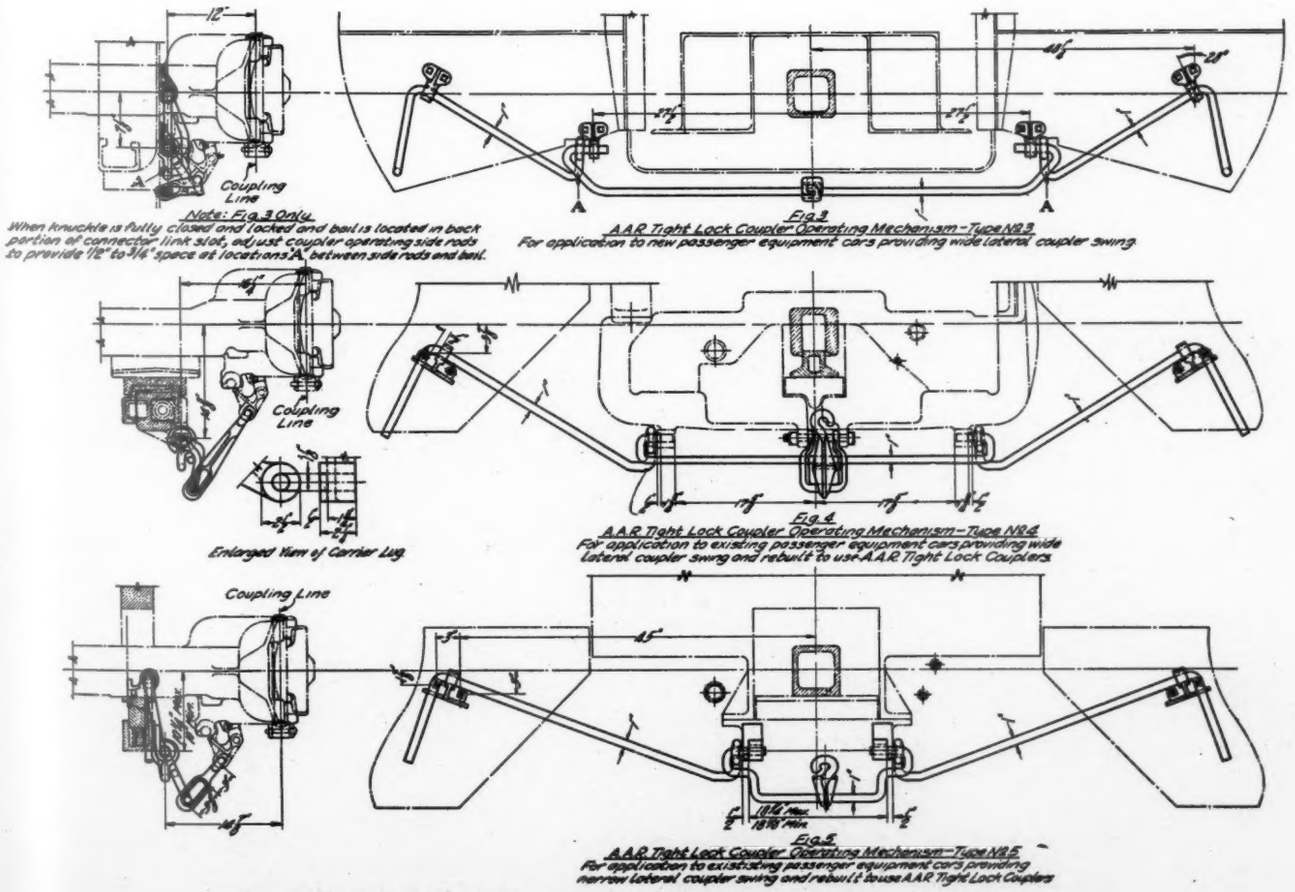
The A.A.R. Tight-Lock Coupler represents a marked departure from the types of couplers in use up to this time. The distinctive design features and the close-fitting conditions of the tight-lock coupler make it necessary to change or modify certain of the practices formerly employed in the use and maintenance of couplers. These instructions have accordingly been prepared as a guide to users of the A.A.R. tight-lock coupler, and their careful observance is considered essential.

Storage: Tight-lock couplers and fittings should be stored in a dry place under cover to prevent corrosion of machined surfaces. Oil, or other coatings, should not be used at any time to protect these surfaces against corrosion.

Inspection and Cleaning: Tight-lock couplers are intentionally designed and manufactured to provide tight fitting conditions. Periodic inspection to assure proper operation of the coupler is therefore important. Accumulations of dirt should be removed by opening the knuckle and blowing out with dry air-blast. If necessary, the coupler should be dismantled for this inspection and cleaning.

Lubrication: Tight-lock couplers in service must be kept free from any lubricants that accumulate dirt or other foreign substances, as these will interfere with proper functioning of the coupler. The inside of the coupler head and the internal fittings must not be painted.

Coupler Maintenance: When tight-lock couplers are reconditioned, especially by application of a new knuckle or lock, the full operation of the coupler should be carefully checked to make certain that it is satisfactory. Also, such couplers should be carefully checked for intercoupling with another tight-lock coupler in order to be assured that this operation is satisfactory,



Three approved designs of coupler-operating mechanism for use with the tight-lock coupler

including proper engagement of the anticreep feature. Replacement of parts in the tight-lock coupler must be made using only standard tight-lock coupler parts, such as knuckles, locks, etc. The space between the underside of the lock and the lock shelf on the knuckle tail must not exceed 5/8 in. Any adjustment of parts necessary to maintain the tight-lock coupler should be made in such manner that the surface, or surfaces, adjusted will remain smooth and true.

Coupler Operating Rods: The design of the coupler operating rod should be an approved type. Three approved designs of coupler operating mechanism, to suit varying car construction conditions, are shown in an accompanying illustration. It is recommended that these approved designs be used whenever practicable. When special design operating rods are necessary they should be designed to avoid any interference with the proper functioning of the coupler.

Coupler Operating Rod Stops and Brackets: The operating rod stops located at the sides of the car should be of such design that they will not be deformed in service, thus changing the position of the rod. Preferably, such stops should be against the car body and not a projecting member. Operating rod brackets should be kept in alignment to prevent binding of the rod. When rubber grommets are used they should be of a type that will not interfere with free movement of the rod.

Steam and Train Line Supports: Any device or arrangement used to support steam or train lines should be located to avoid any interference with any of the coupler operating parts, including operating rods. The location of these supports should be carefully checked under various coupler positions and different types of train lines in order to be assured that interference will not occur during train operation. Train line supports should not be attached to any portion of the coupler.

Coupler Carrier Supports: Tight-lock couplers must be supported in a level position on the coupler carrier and this position should be maintained. When tight-lock couplers are permitted to droop, satisfactory coupling cannot be accomplished for the reason that excessive pressure must be applied to lift the couplers and bring the faces of the bars and knuckles parallel and in full contact to allow the lock to seat.

Intercoupling: When tight-lock couplers are intercoupled, one with another, the operation may be performed satisfactorily with either or both knuckles open. When tight-lock couplers are intercoupled with any other types of couplers, it is recommended that the knuckle of the tight-lock coupler be closed and the knuckle of the engaging coupler be open. When a coupling is made between two tight-lock couplers or between a tight-lock coupler and any other type of coupler, inspection should always be made to make sure that the telltale hole is fully visible. If the telltale hole is not fully visible, the tight-lock coupler is not properly locked.

Tight Lock Coupler Attachments: There are now several designs of tight-lock coupler shank and attachments in service. These arrangements, including draft gears, should be inspected periodically and when necessary adjustments made to eliminate slack. Total free slack should not be permitted to exceed 1/8 inch. One of these arrangements is a machined ball on the end of the coupler shank that assembles in a machined socket in the yoke head. These ball and socket arrangements are protected by an impregnated canvas boot that attaches to the yoke head and wraps the coupler shank. These arrangements should be frequently lubricated and careful inspection should be maintained to be sure that the protecting boot is properly and securely adjusted.

The report as a whole was signed by R. L. Kleine (chairman), assistant chief motive power—car, Pennsylvania System; H. W. Coddington (vice-chairman), chief chemical and test engineer, Norfolk & Western; C. J. Scudder, chief of motive power, Delaware, Lackawanna & Western; L. P. Michael, chief mechanical engineer, Chicago & North Western; J. P. Morris, mechanical superintendent, Atchison, Topeka & Santa Fe, and H. W. Faus, engineer motive power, New York Central System.

In submitting this report the chairman changed the committee recommendations with respect to the design of the tight-lock coupler and attachments in that this design be submitted to the association for adoption as recommended practice, instead of as standard.

(The report was accepted and the recommendations referred to letter ballot.)

Report on Car Construction

During 1938 the full Car Construction Committee, in cooperation with the Freight Car Design Committee of the American Railway Car Institute, undertook an economic study of lightweight box-car designs in line with the program of 1932 which consists of items (a) to (f) inclusive, as covered by Appendix A to Circular DV-768 for that year.

It was agreed that this study would have for its basis the design of a steel-sheathed wood-lined box car having clear inside dimensions of 9 ft. 2 in. wide, 10 ft. high at eaves and 40 ft. 6 in. long as shown by general arrangement Plate 1500, Appendix A to the Annual Report of 1937, Circular DV-920.

It was further proposed to have developed through cooperative efforts of the car builders, the railroads and the specialty manufacturers, designs of the following types of construction: (1) Lightened design in carbon-steel riveted construction; (2) Combination of carbon-steel riveted and welded construction; (3) Alloy steel with combination of welding and riveting; (4) Alloy steel largely of welded construction. This study has been actively followed and tentative designs have been submitted but a considerable amount of work still remains to be done before a general statement of the results may be submitted.

This analysis relates to car body design and construction but, in order that relative weight and cost information may be presented on a comparable basis for the complete car in each case, trucks of the conventional spring-plank design of Grade B steel with nominal weight chilled-iron wheels are to be included at weight per car set of 15,600 lb., as reported in Appendix A to Circular DV-920.

As information, it may be stated at this time that when setting up the carbon-steel riveted-construction body complete as one hundred per cent, tentative results show the following body weight comparison possibilities: Design (1) 94 per cent; (2) 89 per cent; (3) 79 per cent; (4) 76 per cent.

On the question of initial cost the indications are that in reasonable lots, say 1,000 cars or more, the costs per unit complete with conventional trucks would be about the same for each of the designs listed.

It should be recalled, however, that although the smaller car body for the A. A. R. standard design of 1932 having clear inside dimensions 8 ft. 9 1/8 in. wide, 9 ft. 4 in. high at eaves and 40 ft. 6 in. long, weighed about 3,000 lb. less than the then best steel-sheathed designs of equivalent size, the results of subsequent extensometer, deflectometer and also impact tests conducted under collision conditions showed that over-all strength of the new design had been increased some 20 per cent or more over the strength of the two steel-sheathed designs tested in the same manner at that time.

The question of desirable or necessary strength for the lightweight designs has not as yet been gone into in detail, but it is the intention of the committee to investigate this feature further with the A. R. C. I. Committee. This is an important consideration because of its possible effect on anticipated service life and ultimate cost, and further study of the matter might conceivably alter the weight percentages here given and possibly also the relative costs.

New House Type and Hopper Cars Ordered May 5, 1938, to April 30, 1939

Design	No. of cars	Per cent of total
A. A. R. throughout or conforming thereto, including lightweight alloy steel to A. A. R. base dimensions, hoppers with inside dimensions to meet specific conditions	11,875	91.98
A. A. R. except 26¾ in. center-plate height	35	.27
Not A. A. R. except inside dimensions	1,000	7.75
Total	12,910	100.00

[Note: Of a total of 18,731 cars, including freight, refrigerator, gondola, flat, stock, and special-type cars not listed in the table, 16,696 cars or 89.14 per cent have the standard center-plate height of 25¾ in., and 2,035 cars or 10.86 per cent have a 26¾-in. center-plate height.]

Standard Hopper Cars

As a result of further experience gained in the construction

and service of the A. A. R. standard self-clearing hopper cars with particular reference to the cars built with the coped-out center sills, certain detail changes to improve the designs were found necessary or desirable.

These consisted principally in the application of a continuous reinforcing angle on each inside bottom edge of the coped-out portion of the "Z" bar center sills to replace the sectional angles formerly shown.

These changes result in a consequent reduction in the number of rivets for the reinforcing angles and the revisions have the joint approval of the A. R. C. I. and the Car Construction Committee.

[The report was signed by T. P. Irving.]

Center-Sill Section for Use with the 25¾ In. Center-Plate Height

In connection with the production of center-sill section Z-26, the steel manufacturers have had difficulty and to reduce materially the tendency of cracking at the corners they propose the following:

"The upper outer radius between vertical web and horizontal projecting long flange of the Z-bar should have outside corner radius of ⅛ in."

This recommendation has the approval of the American Railway Car Institute Committee on Freight Car Design and also the approval of the Car Construction Committee. It will have no appreciable effect on the properties of the section and will also materially reduce the liability of the edge becoming nicked with the resultant possibility of development of cracks.

A. A. R. drawing 525-C has been revised to cover and has been included in the revision of the Supplement to the Manual.

[This report was signed by T. P. Irving.]

Report of Joint Sub-Committee on Box-Car Floors

The question of damage to box and automobile box car floors, due to heavy concentrated loads imposed by power trucks when handling steel sheets, ingots, bars and similar lading, has been discussed during previous annual meetings of the Mechanical Division and has also been the subject of correspondence between the Operating-Transportation Division and the Committee on Car Construction.

Some time ago a joint Sub-Committee of the Car Construction Committee and the Design Committee of the A. R. C. I. was appointed to study this matter.

After consideration by this committee and the full Committee on Car Construction, it was decided that in view of the information now available and the experience of certain railroads, suitable designs of heavier floors could be developed to cover the situation without conducting special loading tests.

Sketches are being prepared and within the next month proposed floor construction will be sent out under special letter ballot circular.

[The chairmen of the joint subcommittee are T. P. Irving for the Car Construction Committee and W. H. Mussey for the American Railway Car Institute.]

Trucks for High-Speed Freight Service

In the report for 1937 a brief statement was given under heading Light Weight and Less Expensive Trucks for Load-Carrying Cars Used in Regular Passenger Service, Including High-Speed Operation.

This related to a then proposed program of tests for the purpose of obtaining information for use in the development of a lighter and less expensive truck than the conventional equalized swing-motion passenger truck for use under certain types of load-carrying cars operated at the head ends of passenger trains in fast through service and also perhaps applicable to some extent to locomotive tenders. Also, to determine specifically the value first of swing motion, and second, of separate equalization for such service.

Subsequently the instructions to the committee were changed with request for investigation and tests of trucks for high-speed freight service to meet the changing demands of such operations. This matter has been actively progressed under the immediate direction of the mechanical engineer of the division and the tests will be started about June 1, 1939.

Sub-Committee on Side Frames and Bolsters

During the past year no new design of cast-steel side frames of either alloy steel or Grade B carbon steel was submitted to the sub-committee for consideration. The pressed and welded rolled steel side frame has, as stated in the Report of 1938, successfully passed the static tests but as the frame has not yet passed the required dynamic tests, approval has been withheld. Applications pending include side frames for a 40-ton and a 70-ton truck, each spring-plankless and of carbon steel, one 50-ton alloy steel and one 50-ton pressed and welded rolled-steel design, each, for a truck with spring plank.

Reference was made in the 1937 and 1938 reports of this subcommittee to the new designs of pressed and welded rolled-steel side frames and bolsters for 50-ton cars submitted for approval by the United States Steel Corporation. The first design of 50-ton capacity bolster met successfully the requirements of A. A. R. specification for Grade B carbon-steel bolsters and was approved in 1937 for application to cars in interchange, not exceeding 1,000 car sets.

Recently an additional design of 50-ton capacity and two designs of 70-ton capacity bolsters were submitted by the United States Steel Corporation, samples submitted successfully passed the specification requirements of A. A. R. specification for Grade B carbon-steel bolsters and were approved for application to cars in interchange, to the extent of not more than 1,000 car sets of each design. In addition to these bolster designs, one carbon-steel 40-ton spring-plankless design with the Barber stabilized truck was approved.

[H. W. Faus is the chairman of this joint subcommittee.]

Definitions and Designating Letters for Freight and Passenger Cars

During the past year the committee has passed upon a number of requests from car owners for designating letters for new types of passenger and freight cars. After reviewing these requests they have been presented to the membership for approval by letter ballot.

The committee recommended the following new symbols and definitions:

"DE"—Dining Car for use of patrons, fitted with tables and chairs or seats, but without a kitchen.

"DK"—Dormitory Kitchen Car. One portion provided with a kitchen for preparing food for patrons, the other portion equipped as a dormitory for the use of the crew.

"DLC"—Lunch Counter Car. One portion provided with a kitchen for preparing food for patrons, the other portion equipped with a lunch counter.

"DCL"—Lunch Counter Lounge. A car fitted with a lunch counter and kitchen, the other portion equipped with seats or movable chairs. The latter end may be designed as a lounge, observation room or car may be equipped with an observation platform.

[The chairman of this subcommittee is G. S. Goodwin.]

Other Items

During the current year, in accordance with the provisions of the first paragraph of Interchange Rule 3, the committee reviewed and approved seven designs of chlorine container cars, from which thirteen cars were built; one design of lightweight steel-sheathed refrigerator car, from which one was built; one design of well type car, from which six were built; one special design of flat car, from which two were built; one design of tank box car for liquid oxygen, from which one was built; one design of lightweight-steel welded box car, from which fifty were built; one design of pulp-wood rack car, from which fifty were built; one design of lightweight side-dump car, and one design of roofed hopper, from which thirty-five were built. One underframe design for a 50-ton box car was also reviewed.

The subcommittee on revisions to the Manual and Supplement to the Manual made a review of portions of Sections B, E, and L, the entire sections of C and D of the Manual, and the complete Supplement to the Manual. Changes were made, and the revised and new sheets are available and will be issued in the regular manner. The sub-committee suggests that pages which have been eliminated and replaced, be preserved as a matter of record and for reference purposes.

The sub-committee on revision of Interchange Rule 86 for

adjustment of the rail load limit capacity to compensate for various weight wheels now in general use is of the opinion that although the proposed note formulated for addition to Interchange Rule 86 would accomplish the immediate objective sought, it would be necessary before placing the revised rule in effect to adjust upward the capacities of certain axles. It has been considered advisable to await the outcome of fatigue tests, now being made under the direction of the mechanical engineer with full size axles, so as to have available more definite information with respect to the points of highest stresses in such axles for comparison with changes in stresses involved in the adjustment of axle capacities. It is apparent that the fatigue-test results will be of considerable aid to the sub-committee in deciding the extent, if any, to which changes in capacities of present standard axles might ultimately be recommended.

It is recommended that the item of definitions and designating letters be submitted to letter ballot of the members.

The report was signed by P. W. Kiefer (chairman), chief engineer motive power and rolling stock, New York Central System; T. P. Irving (vice-chairman), engineer car construction, Chesapeake & Ohio; W. A. Newman, chief mechanical engineer, Canadian Pacific; F. J. Jumper, general mechanical engineer, Union Pacific System; J. McMullen, superintendent car department, Erie; F. A. Isaacson, engineer car construction, Atchison, Topeka & Santa Fe; G. S. Goodwin, mechanical engineer, Chicago, Rock Island & Pacific; E. B. Dailey, engineer car construction, Southern Pacific Company; J. T. Soderberg, general foreman, Pennsylvania; T. M. Cannon, engineer car construction, Chicago, Milwaukee, St. Paul & Pacific, and H. L. Holland, assistant engineer, Baltimore & Ohio.

Discussion

One member directed the attention of the committee to the fact that on the 40- and 50-ton steel-sheathed box cars the end lining is applied vertically and the stringers horizontally so that when these cars are loaded with grain the lading gets down behind the end lining and lies on the horizontal stringers. It was suggested that the stringers be placed vertically in the car and that the end lining be laid horizontally so that the lading will fall down to the floor, thereby minimizing the possibilities of the car becoming infested with vermin.

(*The report was accepted and referred to letter ballot.*)

Locomotive Construction

Design of Fundamental Parts of Locomotives

Wheel Centers of the Thin-Wall Type

In previous years your Committee has made report on the number of applications made on various Railroads, of wheel centers of thin wall section type. It was decided to discontinue listing all applications as they have become too numerous and therefore, this year we have shown only defects that have developed in the various types of wheel centers to date and feel report of this kind will give more information to members than the actual applications and will be of benefit to the manufacturers in discovering defects in design and making necessary correction for overcoming same.

[The report includes tabular details of each failed wheel center. A summary of the failures of wheel centers of this type is shown in the table.]

Summary of Failures of Thin-Wall Driving-Wheel Centers

Manufacturer	Total no. of wheels in service	Total defective	Percent defective
No. 1	861	35	4.0 Percent
No. 2	7437	30	.4 "
No. 5	502	1	.19 "
No. 3	239	10	4.1 "
No. 4	995	5	.5 "

Design of Frame Pedestal Toes

Sub-Committee has been requested to prepare proposed designs to be added to the manual as recommended practice for pedestal toes. After sending out questionnaire and obtaining data on present designs of pedestal toes on later types of locomotives on large number of railroads Committee on Locomotive Construction recommends adoption of standards shown. The dimensions of toe are based on the width of the frame.

Two different styles are shown and it is the intention of the Committee to have both in the manual so that individual roads can select type desired. It is recommended that this be submitted to letter ballot.

[The width of the pedestal is shown as equal to the width of the frame and the length of the toe below the frame is not to exceed one-half the width of the frame. Taper is one in twelve. One style is tapered on both sides; the other is straight on one side. Fillets and corners are 3/8 in. radius.]

[The chairman of the sub-committee reporting on design fundamentals is L. H. Kueck.]

Exhaust Steam Injectors

During 1938, a total of 58 applications of exhaust-steam injectors were made—19 by the locomotive builders and 39 by the railroads. At this date, the builders have orders for 8 locomotives to be equipped with exhaust-steam injectors.

In addition to those listed, there are on order at the Builders two 4-10-2 locomotives which will carry 235 lb. boiler pressure that will be equipped with the turbo-injector.

[The chairman of the subcommittee is Henry Yoerg.]

Development and Use of Oil-Electric Locomotives

During the year 1938 110 Diesel locomotives were placed in service on 30 railroads or operating companies, making a total of 499 Diesel units in operation on 96 separate railroads or operating companies as of December 31, 1938, with no reported retirements, and as of April 1, 1939, there were 92 Diesel locomotives on order for 21 railroads or operating companies.

The diversified use of the Diesel locomotive is indicated in the horsepower of those units delivered as of December 31, 1938, as follows:

Horsepower	Delivered 1938	Delivered prior to 1938	Increase during 1938 per cent
Less than 300	10	13	77.0
300 to 600	2	116	1.72
600 to 900	51	184	27.6
900	30	43	69.7
950 to 6,000	17	33	51.5

The 600- and 900-hp. Diesels still appear to be the most popular units, although their use is confined principally to switch and transfer service.

The maximum horsepower used in combination up to this time is 6,000. Three units of 6,000 horsepower were placed in service during 1938.

No additional units were assigned in freight service during the year 1938.

As of December 31, 1938, there is a total of 47 Diesel road passenger locomotives in service ranging in horsepower from 600 to 6,000 as compared with 27 units ranging from 600 to 5,400 hp. on December 31, 1937. As in previous years, no attempt has been made to include those Diesel locomotives operating in articulated trains.

At this time a questionnaire is before the membership for additional information, which was not available for inclusion in this report; however, all reports available to the committee have been carefully analyzed and, as approximately 44 per cent of the Diesel locomotives in service as of December 31, 1938, are in the 600 hp. group, some of them with at much as nine years' service life, and since fortunately replies to questionnaires indicated a greater volume of information covering the 600 hp. Diesels than for any other particular horsepower, this information was assembled and is included in the table showing as of December 31, 1937, the service record of 600-hp. Diesel locomotives on selected railroads.

The committee has been unable satisfactorily to assemble information covering maintenance and operating costs of Diesel locomotives of heavier horsepower, operated in main-line passenger service, due to the fact that there is a variation in accounting practice on various railroads and available information cannot be assembled on a uniform basis. However, member roads are now making returns of information requested in the secre-

Typical Service Records of 600-Hp. Diesel-Electric Locomotives operated by Selected Railroads to December 31, 1937

Railroad Index	No. of units	Years in service	Service years	Hours assigned	Hours operated	Percent assignment operated	Lubricating oil: Gallons used	Lubricating oil: Gallons per hr.	Fuel oil: Gallons used	Fuel oil: Gallons per hr.	Repair cost: Labor	Repair cost: Material	Repair cost: Total	Percent repairs for Labor	Repair cost per hour	Hours operated per unit yr.
1	2	3.0	6.0	46,450	37,392	80.50	5,099	.1364	130,153	3.481	.....	.....	$ 11,740	.....	$ .3140	.....
	6	4.0	24.0	183,679	153,969	83.83	15,314	.0995	912,986	5.930	.....	.....	53,233	.....	.3457	.....
	8	4.0	32.0	233,437	185,086	79.29	18,726	.1012	1,007,945	5.446	.....	.....	58,299	.....	.3150	6,070
2	6	7.95	47.70	421,560	286,350	67.93	*34,981	*.1701	2,150,349	7.510	.....	.....	212,946	.....	.7437	.....
	7	2.5	17.5	175,008	129,079	73.76	12,046	.0933	877,179	6.796	.....	.....	59,998	.....	.4648	6,370
3	1	♯9.0	9.0	78,888	44,373	56.25	10,692	.2410	350,498	7.899	.....	.....	69,222	.....	1.5600	.....
	1	♯9.0	9.0	78,888	46,498	58.94	9,537	.2051	370,725	7.973	.....	.....	59,480	.....	1.2792	5,050
4	1	3.5	3.5	26,923	26,923	100.00	2,239	.0832	170,669	6.339	$ 7,988	$ 2,679	10,667	74.89	.3962	.....
	1	3.5	3.5	23,210	23,210	100.00	3,167	.1364	184,865	7.965	10,071	2,129	12,200	82.55	.5256	.....
	1	2.58	2.58	18,795	18,795	100.00	1,542	.0820	118,598	6.310	5,362	1,320	6,682	80.25	.3555	.....
	1	2.16	2.16	16,239	16,239	100.00	1,251	.0770	104,196	6.416	5,343	803	6,146	86.93	.3785	7,255
5	1	5.25	5.25	46,462	34,744	74.78	4,114	.1184	276,924	7.970	15,905	12,634	28,539	55.73	.8214	6,620
6	1	7.33	7.33	56,666	48,483	85.56	6,300	.1299	406,067	8.375	13,761	14,277	28,038	49.08	.5783	6,615
7	1	2.83	2.83	21,481	19,560	91.06	1,311	.0670	123,930	6.336	7,833	2,254	10,087	77.65	.5157	.....
	1	3.25	3.25	26,333	25,107	95.34	2,266	.0903	150,566	5.997	7,627	3,174	10,801	70.61	.4302	.....
	1	1.33	1.33	10,860	10,139	93.36	1,173	.1157	44,784	4.417	2,664	1,434	4,098	65.00	.4042	.....
	1	1.33	1.33	10,853	9,701	89.39	1,117	.1151	43,657	4.500	2,802	1,556	4,358	64.30	.4492	.....
	1	1.33	1.33	10,535	9,390	89.13	1,266	.1348	40,896	4.355	2,818	1,169	3,987	70.68	.4246	7,340
8	1	1.46	1.46	10,880	10,425	95.82	743	.0713	62,574	6.002	2,281	714	2,995	76.16	.2873	.....
	1	1.33	1.33	11,014	10,451	94.89	921	.0882	69,040	6.606	2,292	806	3,098	73.98	.2964	.....
	1	1.46	1.46	10,909	10,440	95.70	673	.0645	64,827	6.209	2,110	583	2,693	78.35	.2580	7,370
9	1	1.33	1.33	11,105	8,599	77.43	1,534	.1784	39,927	4.643	4,045	911	4,956	81.62	.5763	.....
	1	1.16	1.16	10,096	7,685	76.12	1,259	.1638	36,076	4.694	3,410	453	3,863	88.27	.5027	.....
	1	1.17	1.17	9,928	8,428	84.89	1,256	.1490	37,649	4.467	2,735	389	3,124	87.55	.3707	.....
	1	1.16	1.16	9,749	6,750	69.24	1,623	.2404	35,287	5.228	2,945	567	3,512	83.86	.5203	.....
	1	1.0	1.0	8,194	4,115	50.22	1,157	.2812	25,738	6.255	2,207	448	2,655	83.13	.6452	.....
	1	6.0	6.0	50,284	35,957	71.51	11,429	.3179	257,431	7.159	13,418	12,237	25,655	52.30	.7135	6,050
Grand Total	51	.....	195.66	1,618,426	1,227,888	75.87	152,736	.1244	8,093,536	6.591	$117,617	$60,537	$703,072	66.02	.5726	6,275

*No lubrication records for 1929, 1930 and 1931.
♯Units in service in 1927—no cost records prior to 1929.

tary's letter of December 12, 1938. It is hoped that this information will be sufficiently complete or that at least selected railroads can prepare this information on a uniform basis to permit of accurate comparison of such locomotives for a future report.

[The chairman of this sub-committee is H. P. Allstrand.]

Standardization of Valves for Locomotives

Your sub-committee reported in 1938 that work was progressing on designs for globe and angle valves suitable for 400 lb. pressure and 750 deg. F. temperature.

There is a very considerable difference of opinion among the various manufacturers as to the proper materials and the design to be used for valves of this character and up to the present time no standards have been developed. Recent investigations, however, have produced information which should be helpful and it is believed that during the coming year the committee will be prepared to make definite recommendations.

[The chairman of the sub-committee is J. B. Ennis.]

Roller Bearings Applied to Locomotives and Tenders

The answers to a questionnaire dealing with practices and performance were summarized in the report. Drawings and instructions of the manufacturers are generally followed for mounting and dismounting bearings. At class repair periods bearings are cleaned and inspected and, if in need of repairs they are returned to the manufacturers by many roads, or replacement parts are ordered and applied in the roads' own shops. Approximately half of the roads reporting have a central shop for this work.

When lubricant is renewed, the bearings are cleaned either by wiping or washing with kerosene, gasoline or light lubricating oil. When one or more axles are removed between shoppings for reconditioning without removing the bearings, the bearings are cleaned, examined and the original tolerances restored. When machining wheels with the bearings mounted, the boxes are covered with burlap, canvas or sheet-metal guards. When equipment is stored, the boxes are oiled or greased and stored undercover. Engines in storage are moved periodically.

Roller-bearing failures result mainly from shelled races and rollers, broken races and rollers, and broken or worn cages. The causes are usually improper cleaning, lack of lubrication, or faulty material and construction.

Reports indicate an increase of 25 per cent to 43 per cent in availability of locomotives with roller bearings. Some roads report little or no difference in road delays due to hot boxes, while others claim a marked reduction. The majority of replies report no increase in mileage between shoppings, while others claim increases of 43 per cent to 100 per cent. Increased mileage between tire turnings run from 20 per cent to 50 per cent.

The reports indicate that the time between bearing renewals is lengthened with roller bearings and that there is a substantial reduction in maintenance—one road claims 50 per cent. Maintenance of driving boxes and hub liners has been materially reduced and reductions in rod-bearing maintenance from slight to 48 per cent for main- and 64 per cent for side-rod bearings are reported. No appreciable reduction in fuel consumption has been found by any of the roads reporting.

[The chairman of the sub-committee is H. Yoerg.]

Shelling of Trailer Wheel Tires

The committee appointed by the chairman of the sub-committee, to visit various shops regarding the machining and handling of trailer tires, developed nothing to account for the shelling. As a matter of fact, one road on which the handling of these tires is very good had more trouble than the others.

Some of the roads have recently adopted the use of heat-treated trailer tires, from which some relief from shelling has been experienced. However, the entire sub-committee feels that additional data should be collected for the next six month period, beginning April 1, 1939, in order to study further the performance of heat-treated tires.

The several roads having trouble due to shelling of trailer tires have been requested to furnish information regarding failures, mileage, and total number of heat-treated trailer tires in service, for a six month period starting April 1, 1939, and ending October 1, 1939.

[E. L. Bachman is chairman of this sub-committee.]

Construction of Locomotive Boiler by the Fusion Welded Process

At the Mechanical Division Convention held in June. 1937, the Committee on Locomotive Construction submitted a report on the above subject. This same subject was referred to briefly at a meeting of the General Committee held on June 29, 1938.

A locomotive boiler constructed by the fusion welded process

was built and applied to Delaware & Hudson locomotive No. 1219 and after stationary tests to comply with Federal requirements were made, the boiler was released for freight service on September 24, 1937, for operation on the Pennsylvania Division of the Delaware & Hudson between Wilkes-Barre, Pennsylvania, and Oneonta, New York, a run of 130 miles. To further comply with Federal requirements, this locomotive was to be taken out of service every three months for the first year so that the boiler could be inspected.

[At the first three quarterly inspections the jacket and lagging were removed and the welding examined under 225 lb. boiler pressure. All seams were found in good condition. At the fourth inspection on September 20, 1938, which was also the annual test, the boiler was similarly examined under 340 lb. hydrostatic pressure. A similar test was made on April 3, 1939. In no case has there been any sign of a simmer or leak from any of the welded seams. At this time the locomotive had made about 105,000 miles.]

The committee will continue to follow this matter during the period of inspection required by the Federal Inspectors who specify that in the first year of service the lagging and jacket is to be removed and the joints examined each three months, in the second year each six months, and yearly thereafter for a period of five years. Each time the hydrostatic test is applied it is to be not less than 50 per cent above the working pressure.

[The chairman of the subcommittee is W. I. Cantley.]

Research Covering Axles, Crank Pins and Bearings

As reported to the General Committee on June 29, 1938, a questionnaire was submitted to the railroads asking for information concerning failures in service of axles and crank pins during the six-year period ending December 31, 1936. The information received from the railroads was tabulated and progress report prepared and mailed to the member roads.

Since that time an additional questionnaire has been submitted to the entire locomotive voting membership calling for extensive information on all crank-pin renewals from November 15, 1937, to February 15, 1938, and on failures only from February 15 to August 15, 1938. A number of replies have been received and as soon as all replies are in it is the purpose to prepare an additional report on this subject for the member roads. As soon as the report is completed it is the intention to send it to the General Committee for approval and upon receipt of this approval, send the report to all member roads. This will probably be ready for distribution early in the fall.

[K. Cartwright is chairman of the subcommittee.]

Obtaining Higher Train Speed Without Reduction in Trailing Load

This subject, as originally referred to the Committee in 1936, presented a problem of moving trains of 750 tons each, excluding weight of locomotive and tender, over level tangent track at speeds of one hundred miles per hour. Consideration was to be given to three forms of motive power, viz.: the reciprocating steam locomotive, the Diesel locomotive and the steam-turbo-electric locomotive. Later the requirements of the problem were changed to call for the movement of 1,000 tons of trailing load at one hundred miles per hour over level tangent track.

In 1937, a special committee was appointed to consider the future development of the reciprocating steam locomotive. The problem of handling 1,000-ton trains at speed of one hundred miles per hour with a reciprocating steam engine was turned over to this committee who are actively engaged with the problem.

The Committee on Locomotive Construction, through its subcommittee on oil-electric locomotives, is keeping in touch with developments in motive power of this type, but it has been only within the last year that there have been built any locomotives of this type sufficiently powerful even to approach the requirements of the problem. The construction and performance of these locomotives will be investigated and reported upon in due time.

The only development along the lines of a steam-turbo-electric locomotive, of sufficient power to meet the conditions of the problem, that has appeared to date consists of the double-unit locomotive recently built by the General Electric Company and delivered to the Union Pacific. Pursuant to a suggestion made by Mr. Burnett, of the Union Pacific, on presentation of the 1937 report of this committee, we requested the privilege of visiting the General Electric works where the locomotive was under construction, for the purpose of inspecting the locomotive and obtaining data regarding it for consideration and use in preparing a report. This privilege was not granted. However, we will continue our efforts to obtain data upon the construction and operation of this locomotive.

[W. I. Cantley is the chairman of the subcommittee.]

Other Items

The subcommittees on Locomotive Guiding and on Stresses in Rods and Motion Work reported progress.

The report as a whole was signed by H. H. Lanning (chairman), mechanical engineer, Atchison, Topeka & Santa Fe; H. P. Allstrand (vice-chairman), principal assistant superintendent motive power and machinery, Chicago & North Western; E. L. Bachman, general superintendent motive power, Pennsylvania; G. McCormick, general superintendent motive power, Southern Pacific Company; W. F. Connal, mechanical engineer, Canadian National; J. E. Ennis, engineering assistant, New York Central; J. B. Blackburn, mechanical engineer, Chesapeake & Ohio; L. H. Kueck, chief mechanical engineer, Missouri Pacific; Henry Yoerg, general superintendent motive power, Great Northern, and K. Cartwright, mechanical engineer, New York, New Haven & Hartford.

(*The report was accepted and recommendations submitted to letter ballot.*)

Operation of Diesel Locomotives

*By H. H. Urbach**

In the last few years, during the period of low earnings of railroads, it has been necessary for railroad officers to take advantage of every opportunity possible to reduce operating expenses.

In analyzing switching operations, it was found that, in a good many places, two and three steam switching locomotives were being used on one 24-hour period. This, then, appeared to be the ideal spot for a Diesel switcher. In some yards it was found practical to work a number of Diesel switchers on 24-hour tricks. We have one such yard, where suitable facilities have been provided for ordinary running repairs, fueling and inspection, and these Diesel locomotives are inspected and such running repair work as necessary is performed during the time crews are changed and during their lunch period. These locomotives are worked 24 hours per day, and are released from service one 8-hour period every week for inspection of pistons, piston rings, cylinder liners, etc., also careful inspection and test of the electrical equipment in order to maintain the engines in good condition.

The operation of Diesel switching locomotives started on the Burlington in May, 1934, when three 450-hp. four-cycle Diesel-electric switchers were purchased. These locomotives were assigned to the passenger yard, freight house and light industrial switching. They were equipped with two four-cycle, six-cylinder, 1,000-r.p.m., 225-hp. Diesel engines, two generators and four traction motors. After being in service two years, these Diesel engines were replaced by the manufacturers with engines having heavier crankshafts, because those originally used in these engines had developed considerable vibration, which resulted in breakage of different parts and which was directly traceable to the light construction of the crankshaft assembly. Since the newer Diesels have been installed, no further trouble has been experienced.

The maintenance cost for the five-year period 1934 to 1938 inclusive, on these three locomotives has been 7.06 cents per mile—2.61 cents of this amount covering general repairs.

Since installing the three switchers in 1934, we now have a total of ten Diesel-electric switchers in strictly yard service,

* Mechanical assistant to executive vice-president, Chicago, Burlington & Quincy.

which are handling 30 eight-hour switch tricks per 24-hour day; and one Diesel-electric locomotive in switching service 8 hours, which in addition handles the work on one branch line. This assignment includes six 600-hp. and two 900-hp. Diesel-electric switchers which differ from the 450-hp. switchers in that they have two-cycle engines.

So far the service obtained from the Diesel switch engines in yard service has been very attractive and satisfactory. The 600-hp. and 900-hp. locomotives have been in service for a period of 20 months and few mechanical failures and delays have occurred. Up to this time these locomotives have not received general repairs. The lubricating oil is changed after 60 days of work. No regular schedule of traction motor inspection has been set up. During 1938 the availability of the 600-hp. and 900-hp. locomotives averaged 98.5 per cent.

No doubt when business and the financial condition of railroads improve, the use of the Diesel-electric switchers will be greatly extended. As the number of Diesel switchers is increased, more knowledge will be obtained concerning maintenance requirements, and more permanent facilities will be provided, all of which will make it possible to establish more definite maintenance schedules.

It is my firm belief that the Diesel-electric switching locomotive has definitely and permanently established itself as the future prime mover for such service, and that the steam switching locomotive will not be perpetuated when new switching power is required.

Diesel Road Locomotives

Early in 1934, we placed the first Diesel-electric road locomotive in operation. This locomotive was powered by a two-cycle lightweight Diesel engine, being an 8-cylinder-in-line with 8-in. by 10-in. cylinders, developing 660 hp. at 750 r.p.m., and weighing approximately 22 lb. per horsepower. Since that time three other locomotives of this type have been built for us and installed in passenger road service. These four Diesel locomotives are handling three and four-car trains, they are averaging 550 miles a day, and up to May 1, 1939, have accumulated 3,498,096 miles.

We also have in service two 1,800-hp. and two 3,000-hp. locomotives with the same type of Diesel engine. The same type traction motors, pistons, connecting rods, injectors, cylinder liners and cylinder heads are used in all sizes of locomotives from the 600-hp. to the 3,000-hp.

The 3,000-hp. locomotives are made up of one 1,200-hp. and one 1,800-hp. unit. A spare power truck was purchased which will fit either the 1,800-hp. or the 1,200-hp., so that in case of a traction motor failure a quick change can be made. This truck provides protection for six engine units with headquarters at Chicago, and which are assigned between Chicago and the Twin Cities, Minn., and between Chicago and Denver, Col.

The 1,800-hp. locomotives are operating on runs of 882 miles a day, and the 3,000-hp. on runs of 1,034 miles a day. The two 1,800-hp. engines have been in operation since December 18, 1936, and up to May 1, 1939, have accumulated 1,413,573 miles. The two 3,000-hp. locomotives have been in operation since November 8, 1936, and up to May 1, 1939, have accumulated 1,754,585 miles.

One of the 1,800-hp. locomotives has its layover at Minneapolis and is maintained at that point on a nine-hour layover, which is the total time between the arrival of train at night and departure the next morning. One 1,800-hp. locomotive is entirely maintained at Chicago on a nine-hour-forty-five minute layover. The two 3,000-hp. locomotives are maintained at both Chicago and Denver; the layover is approximately eight hours. The maintenance work on these two locomotives is divided between the Chicago and Denver terminals, and special facilities have been provided for the character of the work performed at each of these terminals. The on-time performance of these four locomotives on the runs as stated above has been 96 per cent. The availability of all the Diesel road locomotives is 95 per cent.

Just recently a 1,000-hp., two-cycle locomotive of the improved type has been installed. As it has been in service only a short time no comments can be made as to the maintenance requirements. Only certain parts above the crank-shaft of this locomotive are interchangeable with the other locomotives in service.

The average total weight of train per horsepower for the 600-hp. locomotives with three-car trains is 393 lb., with four-car trains 480 lb. The 1,000-hp. locomotive handles 539 lb. per horsepower when pulling its regular train. The 1,800-hp. locomotives handle 422 lb. per horsepower with seven trailing cars. The 3,000-hp. locomotives handle 445 lb. per horsepower with ten trailing cars, and 521 lb. per horsepower with twelve trailing cars.

The failures which have occurred and are responsible for train delays are so varied in character that it is almost impossible to definitely point your finger at any one particular thing; however, the failures that have occurred were due to trouble with traction motor bearings, connecting rod bearings, pistons, cylinder liners, cylinder heads and fuel injectors. As each 1,800-hp. locomotive is equipped with two 900-hp. Diesel engines, where a failure occurs to a traction motor, connecting rod bearing, piston or cracked cylinder head, comparatively little time is lost with the other 900-hp. engine handling the train, as compared to stopping the train and getting a steam locomotive to handle. This same situation applies to the 3,000-hp., as these units are equipped with two 900-hp. and one 1,200-hp. Diesel engine, and where a defective condition develops that makes it necessary to cut out one of the 900-hp. units, comparatively little time is lost with the other two units in operation. If for some reason the 1,200-hp. engine has to be cut out, it is then necessary to use a steam locomotive to handle the train.

As I see it, the successful operation and satisfactory performance of Diesel locomotives in road service resolves itself into a question of a few parts, such as traction motors, power truck wheels, crankshaft, pistons, cylinder liners, cylinder heads and injectors. I will discuss these separately.

Traction Motors

Several road failures have occurred due to hot armature shaft bearings and broken armature shafts. After each failure a thorough investigation was made but due to the damage that occurred, all evidence as to the cause of the failure had been entirely destroyed. In the case of burned up armature shaft bearings, our investigations convinced us that these bearings were failing due to (1) overlubrication; (2) roller bearings damaged in handling the traction motor; (3) bearings damaged because of too much lateral motion accumulating in the hanger bearings; or (4) armature not properly balanced.

In making actual tests we found that quite high temperatures could be set up in the armature bearings by forcing too much lubrication into the housings. As a result of our investigations (1) instructions covering lubrication were changed from 15,000 miles to 30,000 miles; (2) strict instructions were issued with reference to the careful handling of the traction motors in shipping them from the shops and during the time of application; (3) the lateral motion in the support bearings was taken up and maintained at a closer tolerance, and (4) in order to know that the armatures were properly balanced, an accurate dynetric balancing machine has been installed in our shops where every armature is perfectly balanced at the regular inspection periods.

In addition, it was decided to use the cylindrical treads on the power-truck wheels. Tests indicated that cylindrical treads steady the riding of the locomotive and have a definite tendency to reduce the lateral thrusts of the traction motors at high speeds. It is our opinion, with the frail construction of the armature roller bearings (due to the limited space available), and with the very heavy end thrust of the traction motor on the hanger bearings (which on a two-degree curve at 100 m.p.h. amounts to 1,875 lb. per bearing), that the armature breaks out the end of the roller enclosure and causes the bearing to fail and heat. We have also considered the wear on traction motor pinions and on axle drive gears, and as a result have set up specific wear limits which we believe will also have a tendency to assist in eliminating armature shaft bearing failures.

Several failures have occurred account broken armature shafts. We have arranged to use the magnaflux test on the exposed ends of armature shafts each time a traction motor is sent to the shop for mileage inspection. Since putting these practices into effect we have been practically free from armature axle failures and armature shaft bearing failures.

Through the careful inspections that have been maintained since these Diesel locomotives have been in service, we have developed that the traction motors on our 600-hp. Diesel locomotives will run 200,000 miles between inspection and on our

larger Diesel locomotives 150,000 miles. We have 34 traction motors in daily service and have an assignment of 9 for protection and maintenance. The inspection and repair work of these traction motors has been confined to our Aurora shop where the dynetric balancing machines and other facilities have been provided to make all necessary repairs economically and expeditiously.

An undesirable situation exists when an armature shaft bearing fails, as no means is provided to cut the traction motor out of service. As a result the armature drops down on the pole pieces and practically destroys the armature, pole pieces and field coils, and in some cases has caused the wheels to lock and slide. In several instances where this has occurred enroute it has been necessary to set out the locomotive and handle the train with a steam locomotive. In some cases, when an acetylene torch was immediately available, the armature shaft has been cut off. Some means must be provided so that in case of an armature shaft bearing failure, that particular traction motor can be disengaged from the wheel and the locomotive continued to handle the train with the other traction motors.

Power Truck Wheels and Axles

When the Diesel locomotives were first put into road service, they were equipped with a 1½-in. rim wheel according to A. A. R. specification M-107-34. The analysis was: Carbon, .67 to .82; manganese, .60 to .85; phosphorous not over, .05; sulphur not over, .05; silicon not less than, .15.

The service obtained from these wheels was fairly successful and we averaged approximately 104,000 miles during the life of the wheel. In the meantime considerable research work was done by the steel companies and there was developed what was known as a low-carbon molybdenum wheel, the analysis of which is as follows: Carbon, .48 to .63; manganese, .60 to .75; phosphorous not over, .04; sulphur not over, .05; silicon, .15 to .25; molybdenum, .40 to .50.

When the 1,800-hp. and the 3,000-hp. Diesel locomotives were built they were equipped with this specification of wheel, with a 2-in. rim. We soon found that due to the severe braking, the wheels were thermal checking badly and shelling out, and after running for a period of a year, we found that we were getting only an average of 84,000 miles during the life of the wheel.

We then went to the use of what was known as a high-carbon molybdenum wheel of the following analysis: Carbon, .58 to .73; manganese, .60 to .75; phosphorous not over, .04; sulphur not over, .05; silicon, .15 to .25; molybdenum, .20 to .30.

These wheels gave about the same service as the low-carbon, and as a result of the poor performance of the so-called low-carbon and high-carbon-molybdenum wheels, we changed back to our former specification of what we termed a "plain carbon" wheel, but with a 2-in. rim thickness. As a result we practically eliminated all thermal checking and shelling, and increased the life of these wheels from 84,000 miles to 142,000 miles.

These wheels were all equipped with the standard A. A. R. axle, with the following analysis: Carbon, .40 to .55; manganese, .60 to .90; phosphorous not over, .045; sulphur not over, .05; silicon not less than, .15; nickel not over, .25; chromium not over, .15.

These have been very satisfactory and we have a number of axles in service that have made over 600,000 miles. The mounting and dismounting of power truck wheels is all handled at our Aurora, Ill., Shop, where the axles are given the magnaflux test each times the wheels are removed for renewal.

Crankshafts and Bearings

After several main-bearing stud failures, the crankshaft main bearing caps and the feet members of the crankcase bearings were serrated so there would be no movement of the main bearing caps.

On the connecting rods the upper bantam roller bearings run approximately 200,000 miles before they have to be renewed; on the lower end the first type bearings were primarily 98 per cent lead and we obtained approximately 245,000 miles between renewals. With a later bronze type bearing with a high lead content we expect to obtain over 500,000 miles between renewals. The main crankshaft bearings are renewed every 400,000 miles, at which time they show small shellout spots.

So far it has not been necessary to completely regrind any of the crankshafts. During the combined mileage up to May 1, 1939, of 3,168,158 miles on the four large engines, we have renewed two crankshafts, one because a crank pin bearing had been turned undersize after failure of the connecting rod bearing, the other because of an incipient crack developing after the crank pin had been ground and the sharp edges of the oil hole had not been rounded and polished.

On the small trains up to May 1, 1939, the four 600-hp. locomotives have averaged 874,524 miles, during which time the wear on crankshaft bearings was less than .009 in. It has not been necessary to regrind any of these shafts. Past experience indicates that we can expect at least 1,500,000 miles per crankshaft before it becomes necessary to recondition them.

Pistons, Piston Rings and Cylinder Liners

At the beginning we had quite a number of piston failures, mainly due to improper design and an alloy which had not been perfected for such exacting service as on a two-cycle Diesel engine. After considerable research and development pistons were made of a different alloy, also the interior and ring land construction was changed to obtain more even expansion and better heat dissipation. Later on the forged type pistons were tried out with very satisfactory results. In order to make still further progress in the art of developing pistons, we are experimenting with the latest type cast piston, which it is felt will be superior to any heretofore used.

With the exception of piston rings sticking in the second ring groove from the top of piston, ring troubles have been nil.

During the accumulated mileage up to May 1, 1939, of 6,666,253, we have reground only 21 cylinder liners 1/32 in. oversize. At the beginning quite a number of liners were replaced due to defects in the castings. The liners that did not have any defects are still in service and very few of them have worn beyond .008 in. in diameter. When the wear exceeds .025 in. at the upper end of liners, they are reground 1/32 in. oversize and reused with oversized pistons.

Cylinder Heads

A little over a year ago we experienced considerable trouble with cylinder heads cracking across the valve bridge. After extensive research it developed that the failures were due to an airbound condition in the water cooling system. In one instance we found a leaky gasket on the air compressor head. This air was trapped in the cylinder head, creating a steambound condition, with the resultant overheating and cracking of the valve bridge. That airbound condition was eliminated by the application of ½ in. copper tubing which vents any air in the water cooling system to the atmosphere. Since that has been done we have had very little trouble with cracked cylinder heads. So far no cylinder heads have been scrapped for any other reason.

Fuel Injection System

On the original Diesel engine considerable trouble was experienced with an airbound condition in the fuel injection system, due to utilizing one manifold as a fuel feed and return. That condition was corrected by the installation of a second manifold to serve as a fuel return only, thereby eliminating any airbound condition to the adjacent injector or injectors should one become defective.

Before making the improvements enumerated above, quite frequently fuel injector failures occurred en route; however, since then we have had very little difficulty with defective injectors. When an injector does become defective it is cut out by the crew in charge and the engine continues to handle the train with little or no loss of time.

Maintenance Facilities

The inauguration of Diesel locomotives in road service necessarily meant the establishment of proper facilities for handling the work, and special fueling facilities en route so that fuel oil could be taken with very little standing time. Due to the high-speed schedules on which these Diesel locomotives are operating, it means that most of the stops are only of one or two-minutes duration. Fuel must be taken once between Chicago and Denver, Colo., and this made it necessary to provide one fueling station, which was located at Lincoln, Neb., where it is possible to supply 1,700 gal. of fuel oil in five minutes. As crews are changed at this point very little delay occurs taking fuel over that consumed changing the crews.

At Chicago and Minneapolis, Minn., inspection pit facilities with drop tables and cranes were provided so that power trucks can be changed in a very short space of time. The spare power truck and all protection traction motors are kept on hand at Chicago, where all of the work of changing power trucks and traction motors is performed, except for the one train which is maintained at Minneapolis and in this case when it is necessary to make a change of motors or power truck, the motors or power truck are shipped to Minneapolis.

At Chicago, Minneapolis and Denver special fueling and lubricating oil facilities were provided so that engines can be fueled and also that crankcase oil changes can be quickly made. At Denver no special mechanical facilities were provided and no protection power truck or traction motors are maintained, because we have found it unnecessary to maintain these items at that terminal.

General Repairs

The general repairs on these Diesel locomotives are handled at our locomotive shop, West Burlington, Iowa, where no special facilities have been provided. Because of the general character of the Diesel engine most parts that are renewed are purchased to a standard size and usually, with the exception of lifting the Diesel engine in and out of the cab, the parts can be lifted by hand.

Protection Power

You will note from my discussion in this paper that no mention is made of any Diesel engines used for protection service. With the two 1,800-hp. and the two 3,000-hp. Diesel locomotives operating a total of approximately 3,850 miles a day, some protection necessarily must be provided. When this service was started it was decided that we would not purchase additional Diesel locomotives for this protection but would remodel and modernize four of our Hudson type steam locomotives and build one additional new Hudson type locomotive. These locomotives were modernized to the extent of equipping them with roller bearings on all wheels and valve motion, applying lightweight reciprocating parts and lightweight roller bearing rods.

In addition to furnishing protection for Diesel operation, these steam locomotives are assigned to regular trains operating over the same territory as the Diesel locomotives; for instance, two streamline Hudson-type locomotives operate daily between Chicago and Minneapolis, one locomotive has an entire day layover at St. Paul every day and one has an entire day layover at Chicago—these locomotives furnish the necessary protection for the operation of the Diesel trains between Chicago and Minneapolis. Three of the modern type locomotives are operated on our train Aristocrat between Chicago and McCook, Neb., a total of 779 miles—this provides the necessary protection on the west end of the railroad every day and also makes it possible to protect the Diesel trains en route between Chicago and McCook, Nebraska. One of these locomotives lays over every day at McCook, one is en route and one lays over at Chicago every night. Since these five steam locomotives have all been placed in active service, in addition to protecting the Zephyr trains, they have averaged 12,576 miles per month. One locomotive during this period has averaged 14,513 miles per month.

You will note from the foregoing that in addition to giving us all the protection we need on the Diesel-operated trains, these steam locomotives give a very good account of themselves in handling conventional trains.

In conclusion, I have tried to point out in this paper the great serviceability of the Diesel locomotive in road service and the time required for maintenance, which leads me to believe that the Diesel road locomotive has made considerable inroads on the steam locomotive, and it is my opinion that as time goes along more and more Diesel locomotives will be used for road service, supplanting steam.

Some additional development work is still to be done on the Diesel locomotive to make it entirely satisfactory; however, it appears to me that the same statement can be made about the steam locomotive, in fact, I do not believe that as much progress has been made in the last five years in the development of the steam locomotive as on the Diesel.

Discussion

Written discussions of Mr. Urbach's paper were presented by H. P. Allstrand, principal assistant superintendent motive power and machinery, C. & N. W.; J. P. Morris, general assistant, mechanical department, A. T. & S. F., and G. F. Wiles, Supervisor of Diesel-electric locomotive operation, B. & O.

Mr. Allstrand said it seemed to be quite generally the opinion that the minimum assignment on which Diesel-electric switchers can be justified is 16 hours a day and, for passenger service, 800 to 1,000 miles per day. Even where assignments of steam passenger locomotives are in excess of 500 miles a day, which is not unusual, the service is accomplished with a cost for layovers and relief power in excess of that required for protection of Diesel-electric locomotive assignments. The possibility of carrying on repairs while the unit is en route, he said, permits a greater continuity of service than has ever been possible with reciprocating steam locomotives.

"There are many examples of the dependability of this type of equipment," he said. "We are familiar with assignments which are operating approximately 275,000 miles per year on sustained runs of approximately 2,300 miles on which during an entire year of operation there were no late arrivals chargeable to mechanical failures. True, in many cases repairs enroute were required. It is also true that the locomotives have been continued on the trip with part of the Diesel or electrical equipment cut out, or at least not effective for handling the train, but such cases did not result in excessive delays and at least did not require the power unit being cut off the train."

Mr. Allstrand gave the experience of the C. & N. W. with three 300-hp. switching units which have been in service since 1926 and 1927. They were assigned to 24-hr. service, with an eight-hour period per week for inspection and maintenance. For periods varying from 10 yrs. 9 mos. to 11 yrs. 8 mos. these three locomotives have averaged 84.7 per cent availability, or 5,250 hrs. per year. The consumption of lubricating oil varies from 0.104 to 0.12 gal. per hr., and the fuel oil from 3.817 to 3.939 gal. per hr.

"The record of repair costs for this long period of service is interesting," said Mr. Allstrand. "The lowest average cost per hour for the entire service period for any unit was 64.6 cents and the maximum was $1.07, or for the three units an average cost of 83.6 cents per hour or 13.93 cents per mile. This cost includes running repairs, inspection, general repairs, and parts replacements, and also includes the replacement of crankshafts on two of the units. These crankshafts failed due to faulty design at the connection between the engine and the generator during the first five years of operation. Also of interest is the fact that the average cost of repairs for the last five years service is not greater than the average cost of repairs for the first five years of service.

"During 1937, we placed in service eight 0-6-0 (steam) switchers with a tractive force of 54,000 lb. These locomotives were very desirable for the service and as a result have been in constant demand. They have been operated an average of 4,630 hours per year as compared with 5,250 hours for the Diesel locomotives. The cost of repairs to the steam switchers averaged 88.86 cents per hour or 14.81 cents per mile as compared with 83.6 cents per hr. for the Diesel switchers or 13.93 cents per mile. Of course the steam switchers were in much heavier service than the 300-hp. Diesel switchers."

At the outset of their Diesel-electric operation, Mr. Allstand said the C. & N. W. had followed the practice of removing the locomotives from service every three months for piston, valve and bearing inspection. This was extended, first, to six months and later to one year. For the past two years, he said, none of them has been in the shop for any repairs other than week-end inspections and light repairs.

In 1930 a 600-hp. Diesel-electric switcher was placed in service. Mr. Allstrand said that, for the first eight years, this locomotive has had an availability of 86 per cent; its lubricating-oil consumption has been 0.13 gal. per hr. and its fuel consumption, 8.37 gal. per hr. The average cost of repairs has been 58 cents an hour. This, he said, is accounted for in part by improved design and in part by the greater capacity, which has reduced the abuse from overloads.

"An interesting point in the maintenance of this 600-hr. unit is the fact that it was operated for eight years or approximately 55,000 hours before being shopped for general repairs," said Mr. Allstrand. "The cylinder liners after eight years' service were worn to approximately .0075 in. taper. They were bored and rebushed and the original pistons were re-installed. The main bear-

ings were removed to permit inspection of the crankshaft and were replaced without any repairs. It was deemed advisable to renew the connecting-rod bearings. During this period there were no major repairs to main generator and no major repairs to traction motors other than periodic repainting and baking the insulation, which service was performed at four-year intervals.

"Unquestionably, the original 300-hp. units were damaged and the increased repair cost in part resulted from overloading and attempting to do work for which the machines were not designed."

Mr. Allstrand called attention to an unusual practice of wheel maintenance which the C. & N. W. has adopted on its first four Diesel-electric switchers. When the original traction wheels needed replacement, they were replaced with wheel centers and removable tires. When tires reach the scrapping limit, they are renewed without disturbing the wheel fit on the axle. This is believed to have effected considerable economy.

Mr. Morris, speaking of Diesel-electric switching locomotives, said that placing them in service involved no major problem, so far as the enginemen were concerned, but that the maintenance routine was entirely different from that for steam locomotives and maintenance forces required special training.

Referring to the Santa Fe operation of Diesel switching locomotives 23 hrs. a day continuously between 30-day inspections, Mr. Morris said: "Once each 24 hrs. during the crew's lunch period locomotives are inspected and at the time of monthly inspection careful inspection is made and necessary tests, cleaning, and repairs to equipment are made, also the brakes, trucks, and running gears are given close inspection, and the Diesel engine is inspected for oil leaks, fuel leaks, pounds, valves, piston blows, or any dirty condition inside or outside of the engine.

"With reference to holding locomotives one eight-hour period every week for inspection of pistons, piston rings, cylinder liners, and also careful inspection and test of electrical equipment: While there is no mention made of how the inspection is made, I assume that the condition of the pistons, rings, and liners is determined by an inspection through the wind box. This method does not permit a complete inspection of the pistons, rings, or liners, as only one-third of the parts are visible to inspection by this method and we have had failures of pistons immediately after an inspection of this kind.

"On all two-stroke cycle engines pistons are removed and liners and connecting-rod bearings are inspected once each year, but in some cases we find it necessary to renew these parts between annual inspections. On the later four-stroke cycle engines purchased in July, 1937, no monthly inspection is made of the pistons and bearings, and we have not found it necessary to renew any of the pistons or bearings since the date they were placed in service. At the end of two years' service the pistons will be removed for inspection and at that time the bearings will be given attention, if necessary.

"We are hopeful that, with the new two-stroke cycle 1,000-hp. Diesel locomotives that we have recently ordered, which have the improved type pistons and additional piston cooling, will show up favorably with the four-stroke cycle engine in piston performance."

Mr. Morris said that eleven locomotives, nine of which are in the Chicago territory, work 31 eight-hour tricks daily and average 90.6 per cent availability. He called attention to the fact that they have one experimental locomotive which has been held out of service frequently to make changes in the course of the development of the locomotive. This, he said, would account for the unfavorable comparison with the locomotives on the Burlington.

In light switching service he said that crank-case oil changes are made once in six months. On the 900-hp. locomotives in heavy switching service the oil is changed every 90 days. There is no regular schedule of traction-motor inspection, but one will be developed when sufficient experience has accumulated. Mr. Morris sees no reason why the Diesel-electric switching locomotives should require general repairs until such time as crankshaft renewal is necessary.

In the table are the average operating costs per service hour. The operation of these locomotives, he said, has been very satisfactory, and, where they can be worked continuously for 24 hrs., they will show a more economical performance than steam switching locomotives.

Mr. Morris then took up the experience of the Santa Fe with Diesel-electric locomotives in passenger-train service, from the installation of the experimental 3,600-hp. locomotive placed in service in August, 1935. This locomotive was later remodeled into two 1,800-hp. locomotives and had accumulated 1,026,877 miles to May 1, 1939. The remodeled units are now handling two seven-car lightweight trains between Chicago and Wichita, Kan., a distance of 678 miles. The principal changes made as the result of experience with the original locomotive have been a better system of cleaning combustion air, better cooling of the Diesel engine, providing filters of sufficient capacity to the engines, crankshafts redesigned to prevent breakages, piston redesigned, a revised fuel system, traction motors redesigned to provide better fan construction, and redesign of the main generator armature to overcome too light construction. The steam generators were redesigned and the steam capacity increased.

The assignment of seven 1,800-hp. and three 3,600-hp. Diesel-electric passenger locomotives is shown in the table. For the period April, 1938, to April, 1939, Mr. Morris said that these locomotives have made 2,061,674 miles with an average availability of 94.8 per cent.

Average Cost per Service Hour of 11 Diesel-Electric Switching Locomotives* on the A. T. & S. F.—Year 1938

Repairs	$ .24
Depreciation	.53
Wages of enginemen	1.58
Fuel	.26
Lubricants	.07
Other supplies	.01
Enginehouse expenses	.05
	$2.74

* Three 600-hp. four-cycle, four 600-hp. two-cycle, one 660-hp. four-cycle, and three 900-hp. two-cycle.

Assignment of 10 Diesel-Electric Passenger Locomotives on the A. T. & S. F.

No. of trains	Name of train	Loco. hp.	No. cars in train	Load per loco. hp.	Mileage of run	Scheduled time, Hrs.	Min.
2	El Capitan	1,800	5	458	2,227	39	45
1	Kansas Cityan	1,800	7	558	678	11	45
1	Chicagoan	1,800	7	558	678	11	45
1	San Diegan	1,800	7	561	520*	10	0
2	Super Chief	3,600	9	431	2,227	39	45
1	Chief and	3,600	11	517	451	9	29
1	Ranger	3,600	13	690	451	10	20
2	Golden Gate	1,800	7	566	626†	11	10

* Two round trips
† Round trip

He called attention to the fact that such parts as pistons, connecting rods, cylinder liners, and cylinder heads are not interchangeable between the engines in the 600-hp. to 3,600-hp. locomotives of the two-cycle type, and that none of the parts in the new 1,000-hp. two-cycle Diesel engines for the 4,000-hp. locomotive now on order are interchangeable with the engines now in service. He recommended that manufacturers consider standardization of parts in order to keep down store stocks.

In comparing performance of Diesel-electric locomotives, Mr. Morris thought that much depends upon the character of the service the locomotive renders. He thought the service on the Santa Fe between Chicago and La Junta, Colo., would be comparable with that on the Burlington between Chicago and Denver, Colo. From La Junta, Colo., to Los Angeles, Calif., he pointed out that the Santa Fe had 567 miles of grade, westbound, ranging from 0.6 per cent to 3½ per cent; where the Diesel engines are operated at maximum capacity. Westbound, only one helper is used for 16 miles of 2-per cent to 3½-per cent grade over Raton Pass, and, eastbound, two helpers are used, one for 19 miles of 2.2-per cent grade over Cajon Pass and one for 8 miles of 3½-per cent grade over Raton Pass.

"For about two months," said Mr. Morris, "transcontinental trains were operated without using helper service over 3½-per cent grades. This practice was discontinued as the solder on armature-band wires was thrown off and bandwires loosened up.

The sealing compound around field-pole holding bolts melted and ran out. This sealing compound melts at about 150-deg. C (302 deg. F.). Of course, operating under this temperature condition the insulation was damaged.

"Helpers are now used over Raton Pass, westbound, and over Cajon Pass and Raton Pass, eastbound, but some indications of excessive temperatures are still present, such as insulation on the armature becoming very dry and hard, and solder joints at commutator riser loosening up, which will, in time, result in insulation failures. This condition leads to the opinion that the present motor does not have heat dissipating capacity for present service, and it was thought necessary to provide additional ventilation. This is being done by means of ventilators in the roof of the locomotive, which provide clean air under pressure for the traction-motor blowers."

Traction motors are removed every 200,000 miles and sent to the manufacturer for inspection and repairs, but Mr. Morris said that as more locomotives go into service, consideration will be given to making these repairs in one of their own shops. There has been no trouble with over-greasing of motor bearings, he said. Four ounces of grease is applied to the commutator-end bearing every 25,000 miles, and eight ounces to the pinion-end bearing every 5,000 miles.

With respect to motor-bearing failures which let the armature down on the pole pieces and lock the wheels, Mr. Morris said: "We had similar experience with a 3,600-hp. Diesel locomotive. This occurred on rear wheels of the rear unit, causing the truck to derail on account of the wheels locking and sliding, and could have resulted in a more serious accident if the same condition had occurred on front wheels of the leading truck. In this particular case, any means that would have been provided to disengage the motor in case of an armature-shaft-bearing failure would not have prevented the accident.

"We have built two experimental trucks without the motor on the leading wheels. The motors are placed on the second and third pairs of wheels in each truck. These trucks were placed under the two 1,800-hp. remodeled locomotives and have rendered very satisfactory service."

Crankshaft-bearing failures have caused considerable concern, he said. "We have removed bearings which showed metal fatigue and in some cases the bearings have sloughed away, resulting in many cases of steel-bearing shell contacting the crankshaft journal, making it necessary to regrind the shafts.

"Due to this trouble and to avoid excessive repair costs, we developed on our railroad a crankshaft grinding machine that will grind the journal without removing the crankshaft from the engine. The machine has been loaned to various railroads having scored crankshaft journals, so as to avoid the removal of the Diesel engine from the power plant to remove the crankshaft for grinding.

"The machine will grind crankshaft bearing in from six to eight hours and does accurate work. It removes only such surface metal as is actually necessary. Grinding crankshafts in this manner should result in a service life of at least a million and a half miles, unless unforeseen breakage of the crankshaft occurs."

It is the practice of the Santa Fe to inspect the wheels under Diesel-electric passenger locomotives at each end of the road. Serious trouble from thermal cracks was experienced with some high-carbon wheels. Wheels now used have 3-in. rims and a chemical composition as follows:

	Per cent
Carbon	.57 to .70
Phosphorus	.016 to .028
Manganese	.63 to .72
Silicon	.23 to .28
Sulphur	.020 to .024

Over a period of about two years these wheels have averaged 84,000 miles between turnings and their life has averaged 250,000 miles.

Some axles, Mr. Morris said, have made over 600,000 miles. A few axles have been found defective, with cracks in the wheel seat after 350,000 to 400,000 miles. This is a serious condition and axles are being magnafluxed each time they are removed.

Difficulties have been experienced with every type of piston tried, he said. Piston troubles develop when the engines are working hard on mountain grades and in desert territories where temperatures are high. Cylinder heads crack across the valve bridges, in many cases because water ports in the heads were partially stopped up with scale. Removal of the scale reduced these failures at least 50 per cent. The heads are reclaimed by welding.

"In order to properly handle the maintenance of Diesel locomotives," said Mr. Morris, "we have erected a Diesel locomotive shop at Chicago which is 321.8 ft. long and 112.5 ft. wide, which will accommodate eight 1,800-hp. Diesel locomotives. It is equipped with a Whiting hoist for raising Diesel locomotives to remove trucks and an overhead crane to be used in connection with the handling or dismantling of trucks, removing many parts of Diesel locomotives, including the engine, steam generator, or main generators. Suitable drop tables have been installed so that individual wheels may be dropped when necessary to accomplish this work. Adjacent to the drop pits a wheel lathe will be installed so that power truck wheels can be machined without delay. In addition to the wheel pit and wheel-lathe facilities, the shop is to be divided into three sections, one section for machine tools; one section for repairing and reconditioning cylinder heads, piston assemblies, oil pumps, water pumps, cylinder liners, governors, and all other parts of Diesel locomotives that will require attention; another section will be used as electrical department to take care of all electrical equipment on passenger cars and Diesel locomotives.

"We expect to have the shop completed by the first of August and new machine tools will be installed as are necessary.

"For protection power between Chicago and La Junta, a distance of 992 miles, we have six 4-6-4 type oil-burning locomotives, 300 lb. boiler pressure, 84-in. drivers, and from La Junta to Los Angeles, a distance of 1,235 miles, we have eleven 4-8-4 type oil-burning locomotives, 300 lb. boiler pressure, 80-in. drivers. These locomotives average approximately 17,000 miles per month and are available to protect high-speed trains."

Mr. Wiles said that the B. & O. has had one 300-hp. Diesel-electric switching locomotive in light service on a pier, since 1925, one 600-hp. Diesel-electric switching locomotive, since 1936, and one 1,800-hp. single-unit passenger locomotive since 1935. The larger switching locomotive has worked 18,650 hrs. without general repairs or major replacements. The road locomotive has accumulated 560,000 miles, handling a load of 545 lb. per horsepower.

Six double-unit 3,600-hp. passenger locomotives, in service since 1937 and 1938, are assigned to runs of 448 to 771 miles a day, formerly handled by steam locomotives. They have accumulated a total of 2,000,000 miles with loads up to 894 lb. per horsepower with 14 Pullman cars, he said. Their availability has been 93.2 per cent.

Special facilities, he said, are provided at the terminals of Diesel-electric locomotive runs, for servicing. Work during layovers includes changing wheels and traction motors, washing steam-heat boilers, monthly, annual and other routine inspections and tests. He said that progressive re-conditioning of the Diesel engines is also taken care of at terminals daily, on a schedule such that all cylinder heads, pistons and liners will have been removed and reconditioned within 50,000 miles. Work requiring lifting the locomotive or engine units is performed at the Mt. Clare shops.

"The first road locomotive mentioned," he said "has had some traction-motor armature-bearing failures, and some trouble with connecting-rod bearings shelling out, but practically no trouble with main bearings or pistons and rings. The last six road locomotives have had but one traction-motor armature-bearing failure, and two traction-motor axle-cap bearings heated, none of which caused any delay. But considerable trouble has been experienced with connecting-rod bearings shelling out, main bearings shelling out and some trouble with sticking of piston rings. The manufacturers have developed a new connecting-rod bearing which has given very good service to date, and the trouble with piston rings has been reduced considerably by the application of a new forged-type piston and regular inspection of rings through the liner scavenging ports.

"Little or no delay is occasioned whenever it becomes necessary to cut out one of the Diesel engines. This is dependent on the character of the railroad where this occurs and the load at that time.

"Some trouble has been experienced with traction motors, the majority of which has been traced to broken coils in the armature windings. This weakness of the motors is being improved

by the locomotive builders as they are returned to them. Traction motors are being removed for routine repairs every 200,000 miles. No armature shafts have ever broken and to date it has not been necessary to renew any pinions or drive gears for wear, although three have had broken teeth, but in no instance did they cause any delay, being found upon inspection at the terminal. This could set up a very bad condition inasmuch as the heavy grease used to lubricate the gear teeth could carry a piece of tooth between the gear and pinion and lock the wheels. A means of disengaging the motor armature from the wheel would be desirable.

"On the road locomotives molybdenum heat-treated wheels are used extensively, 36-in. in diameter with 2½-in. rim and A. A. R. standard tread and flange contour. An average of 250,000 miles of service has been obtained from these wheels with two turnings during this service. Axles used are of A. A. R. M-104-34, Class A, Specification, a number of which have been in service 450,000 miles. None have ever broken or been found cracked. The mounting of wheels is handled at the railroad's Mt. Clare shops.

"There have been two main-bearing stud failures, both of which were on engines without serrations in the main-bearing caps. Some of the engines have serrated main bearing caps and they show indication of less movement of the bearing cap. Some trouble is experienced with the main bearings showing fatigue spots and, if not renewed, shelling out.

"The upper needle bearings of the connecting rods are checked each time the rod is removed and any rollers found defective are discarded and the good ones are matched into sets within .0003 in. of each other by the use of a comparator.

"Approximately 150,000 miles is obtained between renewal of the lower connecting-rod bearings of the old or high-lead-content bearing, but these are being replaced with the later bronze-type bearing which is expected to give longer service.

"To date three crankshafts have been replaced, two of which were caused by failure of connecting-rod bearings, and one broke because of a manufacturer's defect in the shaft. The most wear that has been measured on any of the shafts in service is .004 in. and indications are that it will not be necessary to consider regrinding them until after 1,000,000 miles of service.

"Considerable piston trouble was experienced that was corrected to a great extent with the application of later design forged pistons and the intensive inspection of rings, when the second ring is often found to be sticking and ring lands broken. The engine builders are now recommending a new style lower connecting-rod bearing, grooved to supply more oil to the interior of the piston for cooling, which should further help the piston-ring condition.

"No cylinder liners have been reground over-size, although some are being accumulated for that purpose. Very few of these are from wear but are ones that have been scored when piston rings failed. The shoulder that develops in the liner above the ring travel is removed with a special reamer before the piston is removed from the cylinder to avoid fracturing the piston-ring land when the ring strikes the shoulder. Liners are removed for regrinding when wear at the upper portion of the liner exceeds .025 in.

"Considerable trouble was experienced with heads cracking at the valve bridge on account of the cooling system becoming air bound. This condition was improved by the application of vent pipes. Some few cylinder heads still crack at the valve bridges and some across the top at the injector opening. Close attention is given to regularly washing out the cooling system to remove scale that prevents proper dissipation of heat from the heads, liners and radiators.

"Very little fuel-injector trouble is experienced and when it develops during a trip, the injector is replaced or the cylinder made inoperative, the same as on the Burlington."

Mr. Wiles said that Diesel-electric locomotives operating between Washington, D. C., and Jersey City, N. J., are used to protect the longer runs from Washington, D. C., to Washington, Ind., and Chicago.

Following the presentation of the prepared discussions, there was a lively discussion from the floor. Tom Sawyer (American Locomotive Company) referred to Mr. Urbach's statement that pistons, piston rings, and cylinder liners are inspected each week and cited his own experience when, in 1926, pistons and liners were inspected but once a year and later only once in two years. Speaking of the fact that the Burlington has nine spare traction motors with only 34 in service, he suggested that the minimum requirements in this respect were based on the scattered locations of the runs and expressed the opinion that with 1,000 motors in service it might not be necessary to increase the number beyond the present nine.

In reply, Mr. Urbach said that piston inspection on switching locomotives is through the inspection ports. On passenger locomotives pistons are removed after 80,000 miles. Referring to Mr. Sawyer's comment on the number of spare motors, Mr. Urbach added that the stock of spare motors had been built up at a time when they were having a great deal of trouble with traction motors.

E. B. Hall (general superintendent motive power and machinery, C. & N. W.), recalled the various references to the cutting out of motors en route and inquired what was the crew assignment on these locomotives. Mr. Urbach said that cutting out traction motors was a shop job and that a motor failure required setting out the locomotive. He said that the Burlington locomotives are manned by an engineman and a fireman; that, at the outset, these men were picked for their evidence of interest in Diesel locomotive equipment. There are, he said, three supervisors of Diesel-electric and gas-electric equipment who work with this equipment the same as road foremen of engines do with steam locomotives. No other men are assigned to the trains, he said.

John Purcell (assistant to vice-president, A. T. & S. F.) said that a maintainer accompanies the locomotive on the Santa Fe and that, with this man on the locomotive, it is possible to change pistons and carry out other details of maintenance work en route.

Mr. Allstrand said that a mechanic was assigned to each road locomotive on the North Western. Inasmuch as they suspected at the outset that they might have electrical troubles, these men were chosen from among the electricians. He said these men are still assigned to the passenger runs on an eight-hour-day basis. In the new Chicago-Minneapolis Diesel-electric service he said that they do not contemplate assigning a maintainer.

Further Development of the Reciprocating Locomotive

As the result of failure to obtain unanimous approval of the theoretical power requirements and the number of locomotive driving wheels and cylinders required to haul a train of 1,000 trailing tons at a sustained speed of 100 m.p.h., as covered by specifications in our first progress report, following discussion by the General Committee at the meeting June 29, 1938, it was decided that the Committee on Further Development of Reciprocating Steam Locomotive should be continued and it was instructed by the General Committee to work up plans for testing the latest types of steam locomotives, using a dynamometer car where necessary, and to submit recommendations to the General Committee.

Consequently, your committee worked up plans to conduct tests on the Pennsylvania, Chicago & North Western and Union Pacific on level tangent track at speeds of 100 m.p.h., using a trailing load of 1,000 tons. These test runs were made in October, 1938, and the data collected were assembled in report form. This report and the recommendations of your committee contained therein were approved by the General Committee at its meeting March 24, 1939, and, because of its importance to member lines who might be considering the acquisition of new locomotives, it was decided to distribute the report in advance of the regular annual meeting. This has been done and the report is now in the hands of all member roads.

The committee recommends that the above mentioned A. A. R. Passenger Locomotive Test Report be printed in the 1939 proceedings as a permanent record.

With further respect to this report, the committee respectfully calls particular attention to recommendations resulting from these tests contained in report of Subcommittee No. 2 which becomes a part of this report.

The following divisions of the committee, namely: Subcommittee No. 1—technical, subcommittee No. 2—cylinders and valves, subcommittee No. 3—boiler, subcommittee No. 4—design, are now engaged in formulating recommendations for a general design of proposed locomotive capable of meeting the demands

indicated as necessary by the road tests which, incidentally, closely approximate the estimated requirements incorporated in Progress Report No. 1, viz.,

1—4,000 drawbar horsepower as required for a 1,000 ton trailing load at 100 m.p.h. sustained speed.

2—Cylinder h.p.—6,400.

3—Four-cylinder engine.

4—Approximately 300 lb. boiler pressure and 750 deg. F. steam temperature at the boiler.

5—Conventional radial-stayed type boiler.

6—Factor of adhesion, 4.5 if possible.

7—Boiler to be able to supply 100 per cent cylinder demand plus steam demand for auxiliaries.

8—Calculations to be based on bituminous coal having 12,000 B.t.u.

9—Design of locomotive to be of conventional type, with provisions for streamlining.

10—Driving-wheel arrangement to be 4-4 coupled.

11—Engine designed for maximum curvature of 18 deg.

12—Driving-wheel diameter of 84 in. preferred.

13—Anti-friction journal bearings throughout.

The committee now has under consideration a project anticipating the use of a locomotive for experimental purposes in connection with proving or disproving various recommendations for the improvement of existing locomotives and incorporating in the design of new steam locomotives. Further information regarding this will be forthcoming at a later date, probably some months hence.

Particular reference is called to report of Subcommittee No. 1 with respect to recommendations concerning the question of counter-balancing of locomotives. In order to give this important subject the necessary attention the committee has appointed a special subcommittee composed of the following: W. I. Cantley (chairman), mechanical engineer, Mechanical Division, A. A. R.; E. G. Young, professor, University of Illinois, Urbana, Ill.; Lawford H. Fry, railway engineer, Edgewater Steel Company, Pittsburgh, Pa.; A. J. Townsend, Lima Locomotive Works, Inc., Lima, O.; H. Glaenzer, vice-president, Baldwin Locomotive Works, Philadelphia, Pa.; J. G. Blunt, mechanical engineer, American Locomotive Company, Schenectady, N. Y.; W. R. Elsey, mechanical engineer, Pennsylvania, Philadelphia, Pa.; K. Cartwright, mechanical engineer, New York, New Haven & Hartford, New Haven, Conn; H. H. Lanning, mechanical engineer, Atchison, Topeka & Santa Fe, Topeka, Kan.

This subcommittee has already started to function and it is hoped will be in position to make recommendations within a few months.

Subcommittee No. 4—Design, will be in position to make available a general drawing covering a tentative design of proposed locomotive capable of hauling a 1,000-ton train at a 100 m.p.h. sustained speed on tangent level track. This design will be forthcoming in the near future, at which time it will be made available to the full membership of the association.

The committee gratefully acknowledges the invaluable assistance and the cooperation extended by those who have participated in its work, particularly the Pennsylvania, Chicago & North Western and Union Pacific, which furnished the equipment for the test runs and over which lines the tests were made.

Report of Subcommittee No. 1—Technical

The entire question of counterbalance is in a chaotic condition. Quoting from a letter written by Mr. Cantley to Mr. Ellis on April 26, 1939: "As you will recall, there was a recommended practice of counterbalancing locomotives adopted in 1931*, but in 1934 the Committee on Locomotive Construction reviewed this matter, and included in their revision the cross-balancing of the intermediate drivers.** Since 1934, operating conditions of steam locomotives require schedules for considerably higher speeds than were required prior to 1934, and operating at these higher speeds of necessity requires more refinement in counterbalancing. . . . This has been demonstrated over the past year or more through some tests made by several roads at very high speeds." In view of these conditions and our own study of the conflicting processes now used in balancing, this subcommittee proposes to prepare a "primer" or "textbook" on counterbalance, in which there shall be set forth, with fully calculated examples, a full theoretical treatment of the dynamic counterbalance procedure, which after approval by the main committee will be used in analyzing the balance conditions of several existing engines, and which may be of assistance to the new counterbalance committee elsewhere referred to.

Further, in view of these conditions, this subcommittee placed before the main committee the recommendation that it recommend to the General Committee of the division a series of tests under service conditions designed (a) to determine the portion of the reciprocating weight, in terms of the weight and length of the locomotive, which may remain unbalanced, and (b) to determine the absolute merit, in terms of locomotive riding and rail effect, of various methods of balancing.

[The chairman of this subcommittee is E. C. Schmidt.]

* Based on Mr. Riegel's Subcommittee report in the 1930 Proceedings, which dealt with the main driving wheels only.

** This is further explained in the last paragraph on page F-140A-1935 of the Mechanical Division Manual which reads: "In cases where there are two main wheels such as the locomotives whose main rods are coupled to the main side rods, the second pair of main drivers should be cross-counterbalanced as well as given its portion of reciprocating balance as is done with the conventional type of coupling."

Subcommittee No. 2—Cylinders and Valves

On May 1, 1939, at Pittsburgh, Pa., Subcommittee No. 2, with full membership attendance, held a joint meeting with Subcommittee No. 1.

The purpose of the meeting was to report on a proposed new valve gear and poppet valve design. The committee had before it a statement giving full information in connection with this proposed valve gear and poppet valve design based on cylinders 21¼ in. by 26 in. Similar information was also shown for a 12-in. piston valve operated by a Walschaert valve gear.

The joint committee discussed this information with relation to the problem of obtaining more efficient cylinder performance, particularly at high speeds. The conclusions reached are given below.

Ratio of Expansion

High cylinder efficiency requires a high ratio of expansion, which means a short cut-off. With conventional valves and valve gears the limit of satisfactory operation is reached when the cut-off is shortened to about 25 per cent. If shorter cut-offs are tried the early release operates against full expansion and the early compression leads to excessive compression pressures.

The information available regarding the new type valve gear and valve design indicates that with a cut-off of 15 per cent, or perhaps even less, a satisfactory sequence of valve events can be obtained. The resultant high ratio of expansion should give a correspondingly high degree of cylinder efficiency. The mechanical problems involved in operating with short cut-offs were discussed. It was concluded that there does not seem to be any practical or theoretical objections to the use of a 15 per cent cut-off on a locomotive. This view is supported by stationary and marine engine practice.

Water Rate

The high ratios of expansion obtainable with poppet valves and special valve motion will produce high cylinder efficiency. It is believed that it should be possible to design cylinders to operate at 400 r.p.m. (100 m.p.h. with 84-in. drivers) with a water rate of 14 lb. of steam per h.p.hr. With conventional cylinders, valves, and valve motion a water rate of 15 lb. per indicated horsepower per hour is considered to be good practice.

Cylinder Design

To obtain full benefit from improved valves and gears, all steam passages must be carefully designed. Ample cross-sectional area must be provided for the free flow of the steam from the boiler through the superheater and steam pipes to the steam chests. The steam-chest volume must be large and the cylinder passages smooth and of large area so that the quantity of steam required for maximum cylinder demand can be delivered without undue loss of pressure. The exhaust passages must also be of

ample cross-section so that the steam may be evacuated without building up unnecessary back pressure.

Limitations on Cylinder Horsepower

Analysis of the performance of the locomotives used in the A. A. R. passenger locomotive tests of October, 1938, shows that the maximum cylinder horsepower was reached at speeds of 370 to 390 r.p.m., 70 to 80 miles an hour. At higher speeds the cylinder horsepower dropped off. The peak horsepower corresponds to a definite rate of steam flow through the steam passages. The speed could be increased by increasing the rate of steam flow, but this entails greater frictional losses. These losses cut down the initial pressure and increase the back pressure so that the mean effective pressure is reduced. To maintain these higher speeds the load must be reduced so that the locomotive operates at a lower cylinder horsepower rate.

The joint committee points out that over-all locomotive efficiency can be improved and the speed at maximum horsepower can be raised if ample valve openings are obtained and if all cylinder passages are designed for a free flow of steam.

Recommendation

In presenting this report the joint subcommittees express the opinion that they have carried their study of the subject as far as they can go by theory alone. It has been shown that it should be possible to make considerable improvement over the efficiency obtainable with conventional cylinders and valves. The next step is to demonstrate this improvement in practice.

The joint subcommittee recommends strongly that the A. A. R. Mechanical Division be asked to carry out tests of a locomotive fitted with improved cylinders, valve gear and poppet valves. Such tests would show the advantages to be obtained from high ratios of expansion and unrestricted steam flow.

[The chairman of subcommittee No. 2 is Lawford H. Fry.]

Report of Subcommittee No. 3—Boilers

The subcommittee made a study of the comparative advantages of Belpaire vs. radial-stay type back-end construction. It also considered the barrel-type combustion chamber with moderate depth of throat sheet vs. shallow throat sheet with a long firebox equipped with a Gaines arch.

In studying the steam rating for the boiler, we considered available data from Pennsylvania tests, from the C. & O. and from the New York Central Gardenville test, and designed a boiler for 105,000 lb. of steam per hour on the basis of no allowance for the feedwater heater, for coal with 12,000 B.t.u. and for a reasonable rate of combustion with a horizontal mud ring to obtain a level grate.

The subcommittee accordingly prepared a preliminary boiler design which has been sent to the chairman, Subcommittee No. 4. This design is based on an assumed evaporation of 5.4 lb. of water per lb. of coal and an evaporation of 20.6 lb. of water per sq. ft. of heating surface, which will mean a coal consumption of 19,500 lb. per hour and 152 lb. per sq. ft. of grate per hr.

Our committee has discussed possible improvements in boiler performance of existing locomotives rather informally and offers the following comments:

1—The addition of brick arches and superheaters to existing locomotives which were not so equipped has been done to a very general extent and there are probably few existing locomotives now without these accessories to which their application would be justified. We have considered various forms of circulating devices in fireboxes and believe that further experience in actual service may warrant some definite recommendations later on.

2—We have had some discussion on suggested basic modifications in the design of brick arches and superheaters, but do not feel that the time is ripe for definite recommendations.

3—Possible changes in connection with improvement in the cross-sectional area of dry pipe, throttle pipe and steam passages would, no doubt, in many cases reduce the drop in steam pressure at the cylinders and the committee feels that studies of this character would in specific cases be worth while, but as yet, no definite recommendations are made.

4—We are informed that an experimental application of an automatic stoker discharging fuel into the firebox from the front end instead of the rear is showing good results and reducing cinder cutting very materially. This application, however, is still in a preliminary stage and no definite report can be offered at this time.

5—In connection with the use of automatic stokers a definite check-up on the type of grate bars may result in fuel saving and better combustion.

A comprehensive study of drafting arrangements in the smokebox might also result in suggested changes that would improve combustion and improve the steaming qualities of existing boilers.

[The chairman of this subcommittee is J. B. Ennis.]

The report was signed by D. S. Ellis (chairman), chief mechanical officer, Chesapeake & Ohio; W. I. Cantley (vice-chairman), mechanical engineer, mechanical division, Association of American Railroads; W. R. Hedeman, engineer tests, Baltimore & Ohio; J. E. Ennis, engineering assistant, New York Central; W. R. Elsey, mechanical engineer, Pennsylvania; J. M. Nicholson, mechanical superintendent, Atchison, Topeka & Santa Fe; Lawford H. Fry, railway engineer, Edgewater Steel Company; W. E. Woodard, vice-president, Lima Locomotive Works, Inc.; H. Glaenzer, vice-president, Baldwin Locomotive Works; J. B. Ennis, vice-president, American Locomotive Company; E. G. Bailey, vice-president, Babcock & Wilcox Company; and Edward C. Schmidt, professor of railway engineering, University of Illinois.

Discussion

Representatives of the three steam locomotive builders who were invited to discuss this report united in emphasizing the importance of the proposed road tests which will serve as a definite basis for recommendations regarding such important locomotive details as counterbalancing, new types of valve gear, valves, etc. W. H. Winterrowd, vice-president, Baldwin Locomotive Works, said that the report is a valuable contribution to progress in locomotive design and suggested that arrangements be made to keep the proposed textbook on counterbalancing up to date so that it will be of maximum value for reference purposes. He requested that the committee clarify its meaning whenever reference is made to the length and weight of a locomotive to indicate whether the tender is included, as tender weight may be given consideration under certain conditions in deciding what proportion of the reciprocating weights must be balanced.

Mr. Winterrowd said that the poppet-type valve as now developed looks promising, especially when combined with suitable design for a minimum pressure drop in the steam pipes and minimum back pressure. He also referred to the desirability of having locomotives designed for a large cruising radius and maximum availability. He said that further substantial improvements in steam locomotives are now under way and that, for best results, high capacity and reliability of performance must be combined with relatively low first cost and maintenance expense.

J. B. Ennis, vice-president, American Locomotive Company, said that reciprocating steam locomotive design has made important advances in recent years and that still further improvements can be made. He stressed the importance of laboratory research, supplemented by road tests of various important parts of steam locomotives, particularly in view of the lack of complete performance data covering these various details at speeds of 80 to 100 m.p.h.

Mr. Ennis called attention to the formulae used in calculating locomotive horsepower and said that "They represent what would be expected from a locomotive 15 or 20 years old, but, today, they are very much on the conservative side and the modern passenger locomotive develops its drawbar horsepower at considerably higher speeds than indicated by these curves. Furthermore, it maintains its power at a better ratio than shown at the higher speeds. No criticism should be offered as to the use of these formulae in this case, for the reason that no universally accepted formula is in use today for determining the horsepower for modern locomotives. All of the methods in use for the calculation of steam locomotive horsepower, with which I am acquainted, indicate that much better performance could be expected. This is also borne out in the report by the partial curves of actual drawbar horsepower produced by the three locomotives tested, the peaks in these cases being apparently from 50 to 60 m. p. h. Comparisons between these calculated curves and the information given with respect to indicated horsepower should

be most carefully made in order that one does not draw erroneous conclusions. Again, this emphasizes the necessity of securing additional test data under conditions of high-speed operation, and it is hoped that such tests can be made and full dynamometer and indicator records obtained." He also said that a study should be made of important locomotive details which give promise of improvement and suggested tests to determine actual net results, bearing in mind that desirable reductions in steam and fuel consumption should be secured but not at the sacrifice of availability or low maintenance cost.

W. E. Woodard, vice-president, Lima Locomotive Works, Inc., complimented the committee on its constructive work which he said will have a decided influence upon future improvements in steam motive power. He indicated that several potentially important developments in locomotive design are either ready for the testing stage, or nearing that point. Laboratory tests, conducted under proper conditions, may supply information which will save a large amount of time and expense when the test application stage is reached.

Mr. Woodard referred to certain experience gained in laboratory tests in connection with the poppet-valve development referred to in the sub-committee's report. He said "In operating the apparatus on the block tests for observation, it was soon found that it is absolutely essential to produce the various parts of the motion by precision methods and use anti-friction bearings throughout in order to secure a mechanism which, at speeds up to 120 m. p. h., will not deflect or have lost motion. Distorted valve events at high speeds is one of the limitations of our present form of valve motions and it became evident early in our laboratory tests that such refinements were required to avoid distortions in the new gear. I mention this as an example the refinements which are going to be required in further design developments."

In closing his remarks, he referred to the subject of locomotive back pressure as influenced by exhaust-passage design and said that tests, carried out by releasing definite volumes of air at varying pressures through different forms of exhaust passages cast from plastic wood, have provided useful and interesting information. Also that the results are being incorporated in a set of cylinders now under construction. Mr. Woodard referred to these subjects only as examples of improvements which may well be tests in the experimental locomotive referred to in the committe's report.

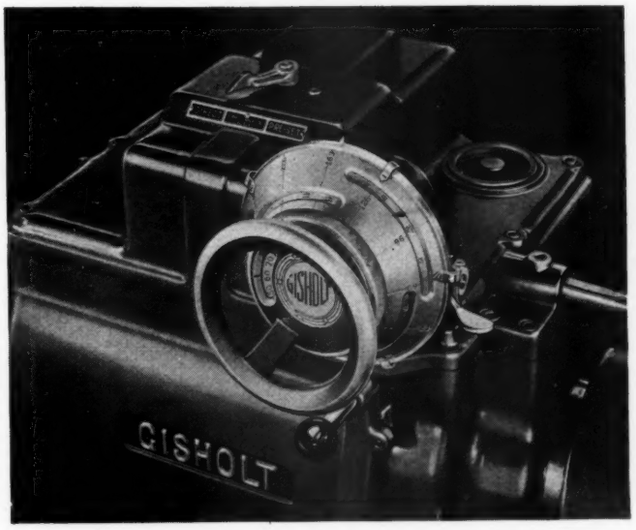
(*The report was accepted and ordered printed in the proceedings.*)

Gisholt Speed Selector

The Gisholt Speed Selector, illustrated, has been developed recently for obtaining easily and quickly any one of the 12 available spindle speeds on Nos. 3, 4 and 5 ram-type universal turret lathes, made by the Gisholt Machine Company, Madison, Wis. The device is power driven and the operator simply sets a dial and the machine automatically makes the shift to give the correct spindle speed. The Speed Selector is particularly useful in keeping machines running and tools cutting at most efficient speeds.

Very often production is low because operators dislike to change speeds for varying diameters of work, especially if much effort is required. The Speed Selector makes speed changing (and speed selection) so easy for the operator that he will enjoy changing to the right speed. This helps to keep machines running at the most efficient cutting speeds at all times and is said in some instances to have increased production 50 per cent.

The Gisholt Speed Selector provides three types or methods of operation. The one used depends upon the particular work at hand. The first is the "Direct" method of operation where spindle speeds are changed simply by turning the dial to the desired spindle speed or to the diameter of the particular cut being taken. Immediately upon making this setting, the machine automatically makes the shift and the spindle rotates at the desired speed. The dial is conveniently located at the front of the headstock and close to the work where it is well within the operator's range of vision. All numbers on the dials can be easily read at a glance. It is also within the normal operating zone and the operator may set the dial with his left hand while indexing the turret with his right hand. Thus, the time for changing speeds is absorbed in the regular machine operation which results in a further increase in production.



Speed Selector which greatly facilitates the use of correct spindle speeds on Gisholt Nos. 3, 4 and 5 ram-type universal turret lathes

The second is the "Pre-Set" method where the desired spindle speed for the next cut may be selected and preset in advance of the actual speed change. That is, while one cut is in progress, the speed for the next cut may be selected by turning the dial. The speed change is then instantly made by merely touching the trip. The actual shifting is done automatically by the machine. Here again the time for speed changing is absorbed during the cutting operation.

The third is the "High-Low" method which may be used at any time in conjunction with either the "Direct" or "Pre-Set" operation. This method provides a quick change between high and low speeds and vice versa. On most work, a high spindle speed is required for drilling, boring, turning or facing and a low speed for threading, tapping, forming or reaming. When the machine is operated in any one of the six high speeds by merely pressing the trip a corresponding low speed is instantly produced. The machine may be returned to the high speed by lifting the same trip. All spindle speed changes are made without stopping the spindle or releasing the main drive clutch.

The hand wheel controls both the inner dial and the outer dial. The 12 available spindle speeds ranging from 28 to 730 r. p. m. are marked on the outer dial. The work diameters from ¼ in. to 12 in. are marked on the inner dial and may be seen through the slots in the outer dial. The work diameters are graduated in small increments for both bar work and chucking work so that the most efficient spindle speed may be easily determined at a glance.

The cutting speeds, which range from 40 to 600 ft. per min., may be seen through the opening at the front of the hand wheel. In operation, the proper cutting speed for the particular metal being turned and the tools used is set on this dial by means of the knurled wheel. After this is once set, it is not necessary to change it

until working on a different metal or with different cutting tools which require more or less feet per minute cutting speed for efficient cutting and for long tool life.

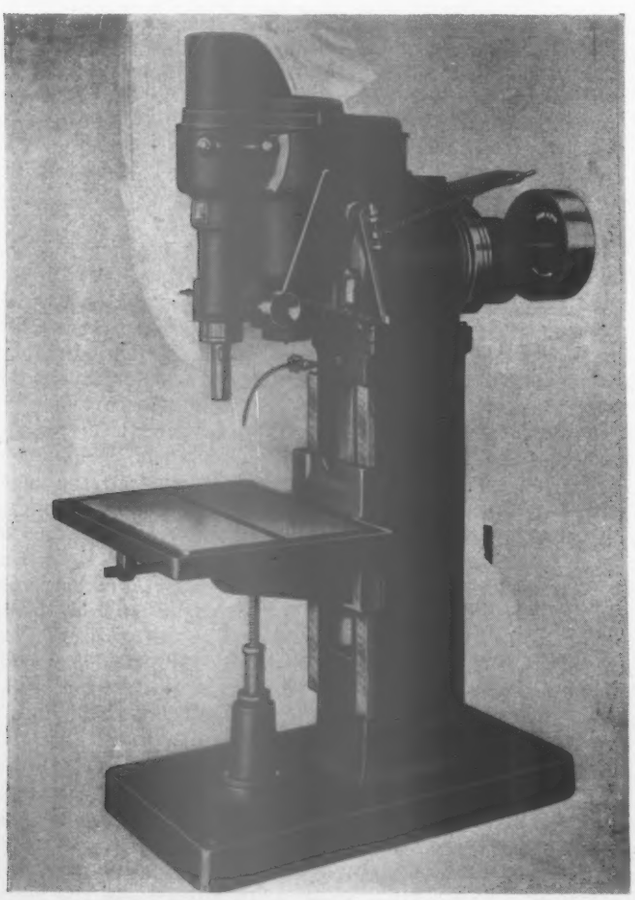
Therefore, any adjustment of the cutting speed produces a corresponding change in the relative position of the diameters, and the most efficient cutting speed will be maintained at all times for each diameter of work by merely turning the dial to that diameter. It can be readily seen that it is not necessary for the operator to stop and deliberate or calculate which will be the most efficient speed for the next cut. Nor will he have to depend upon trial and error method for selecting the proper cutting speed. The speed selector does all that for him and all that is necessary is to turn the dial to the diameter of the cut and the machine will be operating at its top efficiency.

Hi-Duty Nut Tapper

Several new patented features of construction have been incorporated in the line of Gaterman tapping machines which was recently purchased and will in the future be manufactured by the L. J. Kaufman Manufacturing Company, Manitowoc, Wis. For example, the new Hi-duty nut tapper has been designed to operate on the same principle as hand tapping, but with far more sensitivity, as the working strain is weighed to a fraction of an ounce. It is claimed that the absence of unreliable friction adjustments positively prevents tap breakage.

This machine is made in two sizes. The No. 5 will handle ¼-in. to ¾-in. taps in steel and the No. 10 from ⅝-in. to 1½-in. taps in steel. Larger taps can be handled in materials such as cast iron, aluminum, magnesium, and plastics. The drive mechanism is fully geared and enclosed in an oil-tight housing. Complete automatic lubrication is attained by splash and force-feed systems. Any necessary adjustment to clutches or internal mechanism may now be made from the outside without removing the spindle or clutch assemblies. Two levers govern the 4-speed geared transmission of the No. 5 machine and the 6-speed transmission on the No. 10 machine.

Tapping-torque pressure can be controlled or adjusted while the spindle is in operation. Lead screws can be furnished which permit holding the true tap pitch in any material. This is sometimes wanted in soft materials such as plastics, or when threads are to start in a definite relation with the surface or with mating parts. For instance, it is said that a steep taper thread tap can be run in and out of a hole a dozen times without damaging the thread cut in the first pass.



Hi-duty nut tapping machine designed for high production without tap breakage

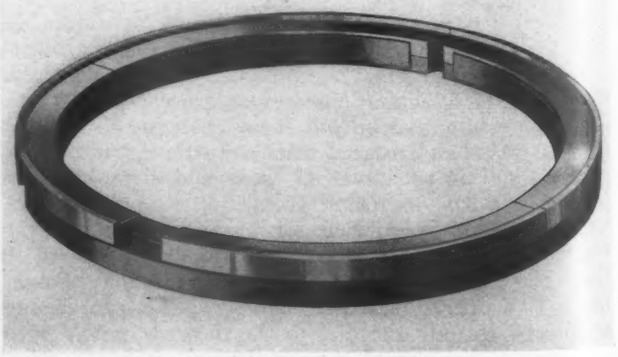
Sectional Bronze-Iron Packing For Locomotive Valves

The Koppers Company, American Hammered Piston Ring Division, Baltimore, Md., has developed a sectional bronze-iron packing ring for piston-valve cylinders. The valve packing consists of bronze and cast-iron segments, steel restraining ring, and a steel expander. It is similar in construction and design to the sectional bronze-iron flanged main cylinder packing made by this company.

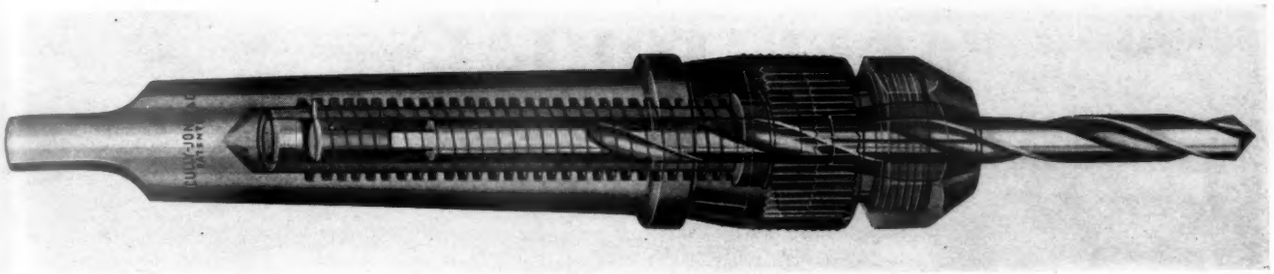
The diameter of the valve is considerably less than the diameter of the valve bushing, and the flanges of the packing rings extend across the face of the valve so that the valve rides on the packing ring and is thus protected from wear. The same valve may be used in standard and oversize bushings, the difference in size being taken up by an increase in the thickness of the packing-ring flanges.

The tension on the bronze-iron sectional valve ring is supplied by an expander made of heat-resisting alloy steel which presses the bronze-iron rings outwardly against the bushing with a constant and comparatively light pressure.

The flexibility of the segmental construction makes the packing ring adapt itself to the contour of the cylinder which is out-of-round or tapered. As only the packing comes in contact with the valve bushing, there is no wear on the valve. These packing rings are free to rotate in the grooves. The restraining ring prevents joint alinement and prevents the segments from springing out and catching on the ports of the valve bushing.



Koppers American bronze-iron packing for locomotive valves



Drill chuck designed so that the drill may be fed out as desired by a screw arrangement

Feed-As-You-Need Chuck

A new Feed-As-You-Need chuck has recently been developed by Scully-Jones & Company, Chicago, which is of ingenious and rugged construction, designed to hold a drill within the chuck body and feed it out by means of a screw arrangement as shown in the illustration. This permits the operator to adjust the drill so that it will go through the work and the drill bushing. With this method of holding and driving drills, there is a tendency to reduce or eliminate breakage because of the shorter grip.

The Feed-As-You-Need chuck can be adapted to drilling, counter-boring and spot-placing to a given depth with the use of the proper combinations. In multiple-spindle machines, all drills can be adjusted to project the desired distance from the spindle. The chuck is made with either Morse taper or straight shanks, and at present is furnished only for drills up to $\frac{7}{16}$-in. size, with $4\frac{1}{2}$ in. in maximum projection.

Drills with broken shanks, tips, etc., can be salvaged and reused by the use of this chuck. All that is necessary is to grind a flat on the drill to fit the slot in the chuck, and then adjust the drill to the desired depth.

Die-Cutting Band Saw

In 1935 Continental Machines, Inc., Minneapolis, Minn., placed on the market what was said to be the first all-purpose die-cutting band saw. The machine was made possible by the development of very narrow band-saw blades which came out about that time. Since then, these narrow saws have been developed to a still higher point of toughness and are made in still narrower widths.

As a die-making machine, the new Model V-36 band saw, is designed to cut shapes and contours in any metal or material. It cuts at the rate of $1\frac{1}{2}$ in. per min. in 1-in. tool steel. In cast iron, it cuts $3\frac{1}{2}$ sq. in. per min. Tilting the work table makes it possible to cut angles as well as contours in one operation. The saw blade leaves a slit only $\frac{1}{16}$ in. wide and cuts the toughest stainless and high-carbon steels, as well as aluminum, brass, plastics and the softer substances. The saws cost about 80 cents per band, and are designed to last for over 600 sq. in. of cutting. For internal cuts saws are instantly welded into bands with an automatic butt welder in the machine.

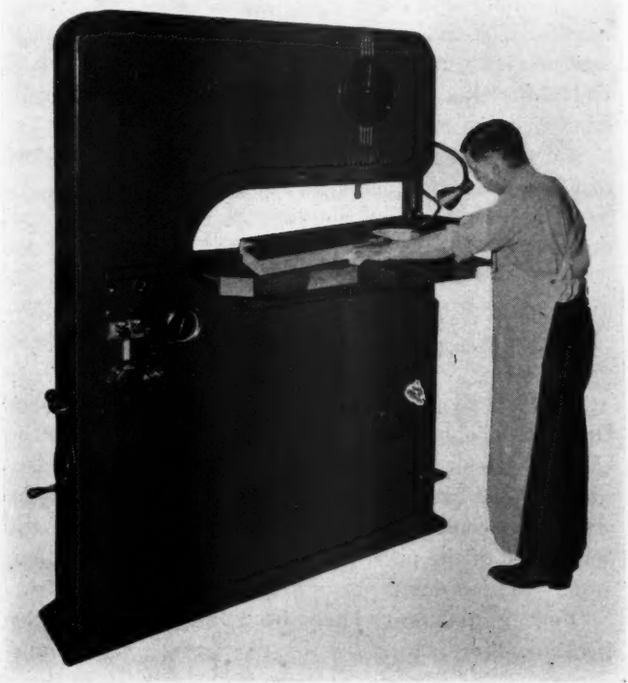
The new machine is massive and rugged in construction. It has a 36-in. throat and 10-in. work height capacity. It is built of arc-welded steel, and the housing also serves as the frame of the machine. It weighs 1,775 lb., complete. The work table tilts in four directions, is 30 in. square and $2\frac{1}{2}$ in. thick, of box type construction.

A 1-hp. motor drives the machine, first, through special Bakelite pulleys which give infinitely variable speed, and then through a silent transmission. The transmission contains eight helical gears, which run in oil. A speed range from zero to 1,500 surface ft. per min, is available in this machine, and a tachometer dial is conveniently located to indicate the exact speed. The correct speed to use for contour sawing is shown on another dial on the machine, which is called the job selector.

A $\frac{1}{4}$-hp. motor drives a small grinder wheel, mounted in the panel just under the automatic butt welder for removing the flash of the weld on the saw bands. An entirely new type of saw guide has been developed for this machine which holds the back of the saws more securely and closer to the work both below and above the work table. These guides are adjustable for wear.

A new piston-type pump is employed for the air jet, which keeps chips from accumulating at the point of work. Ball bearings are used throughout the entire machine at wearing points. Furnished with this new model is a three-power illuminated magnifying glass for close work, 20 saws, two files, and three polishing bands. The electric wiring is centered in one built-in junction box, and each machine is shipped ready to run.

This machine operates file bands and polishing bands for jobs that require high finish after the sawing operation. The Doall is basically a shape-cutting machine, using narrow band saws, but it is possible to use abrading bands in addition to the saw bands. It is said to take only a minute to change bands.



The Doall Model V-36 all-purpose die-cutting band saw

EDITORIALS

Labor-Saving Versus Labor-*Serving* Machinery

Does modern high-production machinery which saves such vast amounts of manual work in many manufacturing and maintenance operations really harm labor by reducing the number of jobs available, or does it help labor by increasing the number of jobs in the aggregate, raising rates of pay and improving the general standard of living? In other words, is modern labor-saving shop machinery a detriment, or is it truly labor-*serving* in the broadest sense of the term?

A discussion of the more or less involved and interrelated aspects of this question may well be left to experienced economists, but the fundamental consideration seems to be fairly clear. It simply is not true, as too many people believe, that a given machine which doubles the output per man cuts employment in half, and endless examples may be cited to controvert this statement. The automotive industry is frequently mentioned as a shining example of mechanization which vastly multiplies both output per man and total employment. Similarly, spinning and weaving machinery in this country is said to produce more cloth annually than the entire working population could make, laboring 365 days a year and using the spinning and weaving methods of the early American colonists. If this modern textile machinery is not labor-*serving,* why not scrap it in the interests of the national welfare? Simply because it gives employment to about 2,000,000 American workers, as compared to a negligible number in India, for example, which still makes cloth largely by hand-weaving methods.

A discussion of machinery and the American standard of living, recently published by the Machinery and Allied Products Institute contains the following pertinent statements: "The highly developed technological society in America has provided more jobs in proportion to population than have been provided outside of agriculture in any society in the world of which we have record.

"In 1870 about 32 per cent of the population of the United States was gainfully employed, according to the United States census. This figure rose decade by decade. In 1930 it was about 40 per cent. Even in the years of the most severe depression in the 1930's the percentage of the population employed was higher than in periods considered prosperous prior to 1900.

"Few occupations have been affected more by mechanization than those in the manufacturing and mechanical industries. Yet, employment today in these industries is almost four times as high as in 1870, whereas population is less than two and one quarter times as large as in 1870. During this period, fifteen major manufacturing industries have been developed as a result of technological advance. They provide direct employment for approximately 1.5 million workers."

And what does all this have to do with running a railroad shop or enginehouse? Simply this—Mechanical department appropriations for new work and even for necessary maintenance operations are definitely limited on most roads under present conditions, and any man-hours of labor saved by a modern machine in one operation are available for other badly needed work. In addition, it may be said that labor-saving machinery which reduces unit prices, increases wage rates and stimulates general employment has a highly-favorable effect upon railway car loadings and earnings, thus completing the circle and making possible the employment of additional railway workers. Improved modern shop machinery and equipment, when installed in railway locomotive shops, car shops and engine terminals, is therefore not only labor-saving, but labor-*serving.*

Accurate Wheel Work Of Increasing Importance

The advent of high-speed train operation in this country is rapidly bringing out into the open a number of problems that were not known or considered of great consequence when train speeds were in the lower ranges. Without doubt one of the most important of these is wheels and the railroads are now faced with the necessity of making a number of changes in practices and shop equipment for the purpose of correcting many existing difficulties and anticipating others that may develop in the future.

Like most other problems of a mechanical nature those which are related to the use of wheels under rolling equipment on railroads may be viewed from two standpoints—from that of design and manufacture and from the standpoint of maintenance. The latter category embraces the whole subject of wheel shop practice and it is upon that subject that this comment is directed—whatever problems there may be relating to manufacture seem to be very well taken care of by those upon whom the responsibility rests.

It has been said that the requirements for a good pair of wheels are rather simple; that the axles be accurately machined, the wheels exact mates, wheel bores concentric with the treads, the treads smooth and round with-

in close limits and the whole assembly mounted to gage and in balance. That these requirements are not so easily attained may be attested to by the fact that many roads are having troubles that, upon investigation, may be traced directly to faulty wheel-shop practices. It is significant that the A. A. R. Wheel Committee took occasion in this year's report to call the attention of the Mechanical Division members to the shortcomings of many roads in the matter of shop practice and included the rather startling statement that a recent survey disclosed the fact that out of 61 shops inspected only 44 per cent were rated as carrying on their wheel work in conformity with the standards set forth in the Wheel and Axle Manual.

In all fairness to the men who are responsible for wheel-shop work it should be said that it is surprising that there is not a great deal more inaccurate work turned out when the character of the equipment and tools with which they have to work is considered. Many important shops are trying to turn out good work with axle lathes, wheel lathes, boring mills and mounting presses that passed the peak of their economic usefulness several years ago. There is no excuse whatsoever for any road operating trains at high speeds to set a standard in wheel work that is anything less than the requirements of the Wheel and Axle Manual and it should be obvious, in many shops, that those requirements cannot be met with the tools and equipment now at the disposal of the workmen.

Aside from the question of the routine operations of wheel work there are two subjects now coming to the front that are worthy of the most careful consideration, namely; the grinding of wheel treads and the dynamic balancing of mounted wheels and axles. The grinding of wheels, particularly chilled-iron wheels, has been performed for a long time but it took high-speed train operation to direct attention to some of the faults that may be corrected and the advantages to be gained by grinding practice. With modern wheel-tread grinders it is possible to produce finished mounted wheels with treads of identical circumference, concentric with the journal and with a perfectly smooth surface for rail contact. Grinding also affords a means of checking the accuracy of the preceding fabricating operations. Advantages to be gained are a reduction of noise incident to wheel and rail contact, reduction of vibration and a reduction in the cost of maintenance of trucks and truck parts.

As for dynamic balancing, two roads, to our knowledge, are now balancing wheels by this method. It has been practiced in Europe for some time. There is, however, a wide difference of opinion, in this country, concerning this practice, with its opponents taking the position that the amount of unbalance likely to exist in passenger-car wheels is negligible, so far as its effect on the riding of the car is concerned.

Probably the most important thing in connection with wheels and wheel work is the fact that operation at speeds in the 60- to 100-mile zone has taken this subject out of the realm of the past, where somewhat rough practices were considered good enough, and projected it into a new field where the utmost in precision methods will be required to produce the results that both safety and comfort demand. The day of guesswork is gone. It is essential that those who are responsible for wheel work view every new development with an open mind and lend their support to whatever scientific research may be needed to develop the best practices.

Motive Power—Steam and Diesel

It is significant that the two items on the program at the Mechanical Division meeting held at New York, June 28, 29, and 30, which were best discussed, dealt with the operation and development of rival forms of motive power. The presentation of the paper on the operation of Diesel-electric locomotives by H. H. Urbach brought forth three prepared discussions as well as a lively and spontaneous exchange of questions and answers concerning various phases of the operation of Diesel locomotives in passenger-train service.

This paper presented an excellent opportunity for a free discussion of the general methods of operation and maintenance of Diesel-electric locomotives. It was the first opportunity for a discussion of operating costs, since there has been sufficient experience to give cost figures real significance. This applies to the Diesel-electric locomotives in switching service alone, however, as neither the paper nor the discussion dealt quantitatively or specifically with costs in passenger service.

The point most stressed in favor of Diesel-electric locomotives, both in switching and road passenger service, is the high percentage of availability and the relatively small amount of standby protection required. Some of its other obvious advantages are greater cleanliness, or at least freedom from cinders; its high rate of acceleration through the lower speed range; the uniform torque, and perfect rotating balance of its driving axles, and its ability to make long non-stop runs.

The report on the Further Development of Reciprocating Steam Locomotives brings into the open the constructive effort which is being made by the steam locomotive builders and, to some extent, co-ordinated by the Mechanical Division, toward the removal or setting back of limitations as to speed and capacity of the reciprocating steam locomotive for passenger-train service. Perhaps the two most important of these limitations now under consideration are counterbalancing and inadequate provisions for the inflow and outflow of steam at the cylinders.

It is a matter of interest, however, that the report does not deal with the advantages of the steam locomotive in comparison with its principal present competitor. What are they? Do they relate to operating convenience? This would not seem to be the case con-

sidering the general opinion of those who have had experience with Diesel locomotive operation that it is simpler to operate and service than the steam locomotive. While it requires the development of a different routine in the matter of maintenance, the evidence seems to indicate that there are no inherent difficulties which are greater in dealing with in this type of motive power than railroad men have long been accustomed to in dealing with steam motive power.

It would seem, then, that the advantages of the steam locomotive do not lie in the locomotive itself, but that they must be looked for in the field of ultimate economy. Here the obvious advantage of the steam locomotive is its much lower first cost per horsepower of rated capacity. Laying aside all questions of the relative availability of oil and coal as locomotive fuel, it would seem that, if the first cost per unit of capacity of the Diesel locomotive were to be reduced and the first cost of the steam locomotive were to be increased to a point where the two were equal, there would be little question as to which of the two types of motive power would be selected for road passenger service.

Aside, then, from the question of maintenance cost, which has not yet been clearly determined in road service, and the question of fuel availability, which at the moment is attracting no particular attention, the advantage of the steam locomotive lies almost entirely, if not exclusively, in its lower first cost. In connection with whatever refinements or changes in design and construction are contemplated, in furthering the development of the steam locomotive in the present competitive situation, therefore, the exploitation of this advantage should always be kept in mind.

Smoother-Operating Passenger Trains

A development of importance to the improvement of future smoothness of operation of passenger trains is dealt with in the report of the Committee on Couplers and Draft Gears presented at the Mechanical Division meeting held at New York, June 28, 29, and 30. This is the tentative proposal of general characteristics and limitations for a passenger-car draft gear which, if finally adopted, should do much to relieve the occupants of railway passenger vehicles from horizontal acceleration and deceleration shocks to which they are now frequently subjected. The feature of the gear which is likely to have most effect on this condition is the proposed limitation of initial compression to 3,000 lb.

The ideal draft gear or, indeed, an ideal cushioning device for any type of service is one which is smooth in its build-up of resistance to applied force from the moment the force begins to build up. Practically, so long as the initial compression to be overcome does not exceed the frictional resistance to movement, the effect should be entirely satisfactory.

The proposed initial compression of about 3,000 lb. is probably as low as it is practicable to go with assurance of maintaining a slack-free friction draft gear for a reasonable service period. Applied to cars with present conventional couplings, which do not completely control the slack, however, such a minimum will not protect the cars in a train from some shocks in the sudden change of acceleration due to the successive application of force to the cars in the train. Under certain conditions of starting and stopping the individual vehicles in the train would be subject to acceleration or deceleration rates varying from, say, 0.2 to about 1 ft. per sec. per sec. Such rates of acceleration or deceleration seem very low. The late Dr. C. F. Hirshfeld, in his investigations for the Electric Railway Presidents' Conference Committee, however, found that the rate of acceleration or deceleration which could be developed without discomfort, depended upon the rate of change of the rate of acceleration, rather than upon the total rate of acceleration finally reached. The difficulty with the rates of acceleration and deceleration developed as the result of initial compression is the rapidity with which they are developed.

If a draft gear of the proposed characteristics is applied to cars with tight-lock couplers, however, so that the amount of free slack between cars is practically eliminated and placed in control of the draft gear, the maximum accelerating or decelerating effect of the uncushioned force due to initial compression will be about 3,000 lb. applied to the entire weight of the train. With a train made up of ten cars each weighing 50 tons, for instance, the maximum effect would be scarcely more than an acceleration or deceleration rate of 0.1 ft. per sec. per sec. This would largely be offset by the total resistance of the train and the effect on the occupants of the cars would probably be satisfactory.

The combination of a draft gear meeting the general characteristics proposed by the committee with the tight-lock coupler promises a decided advance in the smoothness of passenger-train operation.

New Books

A. S. T. M. Specifications for Pipe and Piping Materials for High-Temperature and High-Pressure Services. *Published by the American Society for Testing Materials, 60 S. Broad st., Philadelphia, Pa. 128 pages; spiral-ring binding. Price, $1.25.*

Eighteen specifications covering carbon-steel and alloy-steel piping and tubing, castings, forgings, and bolting for central-station power plants or similar industrial installations of piping materials have been brought together in this reprint from copyrighted publications of the American Society for Testing Materials. Several of the specifications have been approved as American standards by the American Standards Association and a number have been adopted by the Boiler Code Committee of the American Society of Mechanical Engineers.

(*Turn to second left-hand page*)

METHODS AND MACHINERY THAT GUARD LIMA QUALITY

TIGHT TANKS

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High Spots in

Railway Affairs . . .

Motor Transport Continues to Grow

The Interstate Commerce Commission's Bureau of Statistics and Bureau of Motor Carriers reports that Class 1 motor carriers of passengers reported March revenues of $7,659,598 as compared with $7,052,867 for March, 1938, an increase of 8.6 per cent. The number of passengers carried increased 11 per cent, from 9,554,965 to 10,457,676. It is significant that the non-commutation passenger revenues of the railroads were less than 1 per cent greater in March this year than in March last year, and the railroad passengers carried were 12 per cent fewer than in March of last year. The American Trucking Associations report that 212 carriers in 37 states showed total loadings of 1,072,301 tons during May, as compared with 968,874 tons in April and 808,088 tons in May of last year. The May figures this year mark the highest movement of revenue freight by motor trucks in any single month since January, 1938, when the statistics were first compiled.

Harriman Safety Awards

In contrast to the Railroad Employees' National Safety Contest, held under the direction of the National Safety Council, which awards medals each year for the best record for safety to employees, the E. H. Harriman Medals are awarded for the best safety performance, based upon the accident records as a whole as compiled by the Interstate Commerce Commission. This award was established by Mrs. Mary W. Harriman in 1913, in memory of E. H. Harriman. It is continued now by W. A. and E. R. Harriman, sons of E. H. Harriman, and is sponsored by the American Museum of Safety. The Norfolk & Western received the gold medal for the best 1938 safety performance among the larger railroads. It has reduced passenger casualties in proportion to passenger-miles 86 per cent since 1923-25, and employee casualties in proportion to employee-hours, 84 per cent. The Duluth, Missabe & Iron Range, which received the silver medal for the best showing among those roads operating between one and ten million locomotive-miles, did not record a single casualty to passengers, trespassers or at grade crossings in 1938, and only two minor employee injuries were sustained on that road during the year. The Lake Superior & Ishpeming, which received the bronze medal for roads with less than one million locomotive-miles, has operated for seven consecutive years without an employee fatality; moreover, like the Duluth, Missabe & Iron Range, a passenger has never been killed.

I. C. C. Streamlines

Undoubtedly the Interstate Commerce Commission has been a bit jittery about the many criticisms that have been directed against it in the past few years. While the terms of the individual commissioners are long, still they must look forward to reappointment from time to time and occasionally they have been accused of being too politically minded and on keeping their ears too close to the ground. The hearings and debate on the railroad question in Congress during the first half of the year have sometimes reflected upon the Commission and its methods. Whatever the reasons may have been, the Commission announced during the early part of June that a number of changes in its internal organization would be effective July 1. It has been customary for many years for the chairmanship of the Commission to revolve among the different members on an annual basis. Chairman Marion M. Caskie, who was elected the first of this year, served only six months of his term, and effective July 1, Commissioner Joseph B. Eastman began a three-year term. The seven divisions were replaced by five and the individual commissioners are given more authority. The Motor Carrier Division has been criticized because of "motor-mindedness" and while it remains as Division 5, is stripped of authority with respect to rates and securities, and the approval of consolidations, mergers, purchases of motor carriers, formulation of accounts and enforcement of penalties. These matters will be functionalized under other divisions dealing with all carriers subject to the Act. The selection of Mr. Eastman for the three-year chairmanship was interpreted in some quarters as an attempt to put pressure on the promotion of co-ordinations and the elimination of alleged competitive wastes within the railroad industry. It is said, however, that the Commission had no such thought, but merely intended to improve its own internal set-up.

Rail Equipment Fund

Pump priming doesn't seem to have done much good throughout these long depression years, but in still another effort to have business lift itself by its bootstraps, President Roosevelt has suggested a plan over the next seven years for a $3,060,000,000 revolving fund for self-liquidating loans. It is planned to include $500,000,000 for railway equipment, to be acquired over a three-year period by the government agency, from which the carriers could lease the equipment with an option to buy. Apparently the Administration believes that the larger railroads have a surplus of freight cars which they are renting to the smaller roads at prohibitive rates. The smaller, poorer roads, it is claimed, are being forced to pay one dollar per car per day, when the cost of a freight car is only 55 cents a day. The assumption seems to be that the more fortunately located railroads are gouging the weaker ones. Those high in authority apparently overlook the fact that the railroads could readily finance the purchase of any equipment they might need if they could increase their net. Private capital would be only too glad to help them out on favorable terms. If conditions continue such that they cannot increase the net, then what is the use of adding to their equipment and taking another step toward bankruptcy, if indeed they are not already in that sad state?

Railroad Legislation

It was predicted that the railroad bill would be reported to the House before July 1, but the jam in Congress apparently caused it to be shelved for the time being. At any rate, nothing definite was known concerning it when this paper went to press. Whatever the committee may do in attempting to solve the railroad problem, will, without much doubt, be severely criticized by the various special interests that have shown little regard for the general public interest, but will fight to the limit to feather their own nests. Prompt and constructive action is essential.

Grade Crossing Accidents Last Year

The rail-highway grade crossing casualties decreased in 1938; they were in fact the smallest since 1933. There were 1,517 deaths and 4,018 injuries in 1938, compared to 1,875 deaths and 5,136 injuries in 1937, the latter year, by the way, having had the worst record since 1930. More than one-third of the accidents were caused by motor vehicles running into the sides of trains—35.29 per cent in 1938, as compared with 37.47 per cent in 1937. The 1938 casualties at grade crossings constituted 33.37 per cent of the fatalities and 25.92 per cent of the non-fatal injuries reported in connection with all of last year's railway accidents associated with train operation. A larger percentage of the 1938 crossing accidents occurred in daylight than in 1937—53.06 per cent, as compared with 51.47 per cent. Winter, as is to be expected, is the season of highest frequency and the hour of greatest frequency was between 5 and 6 p. m. in 1938; in 1937 it was between 7 and 8 p. m.

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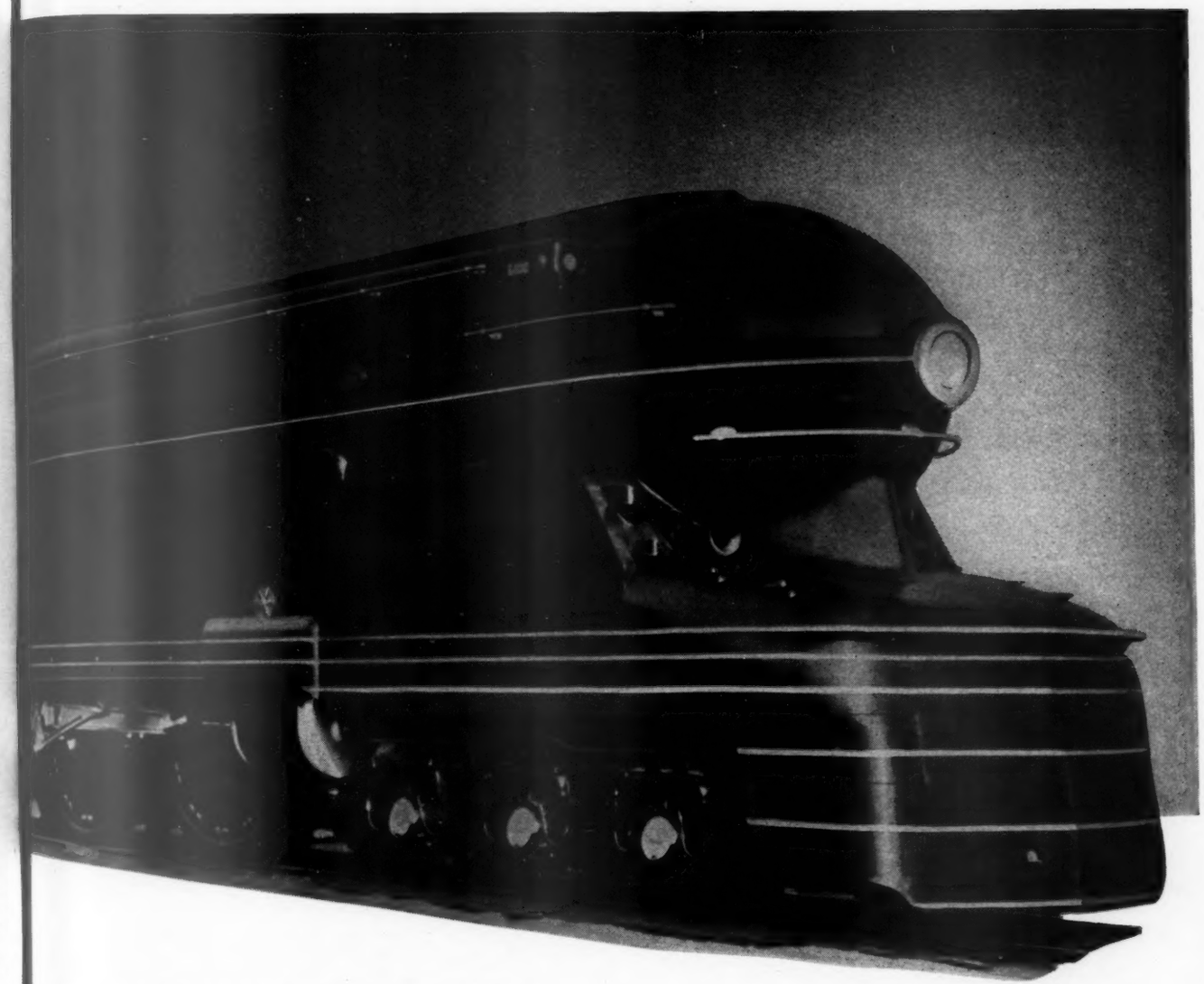
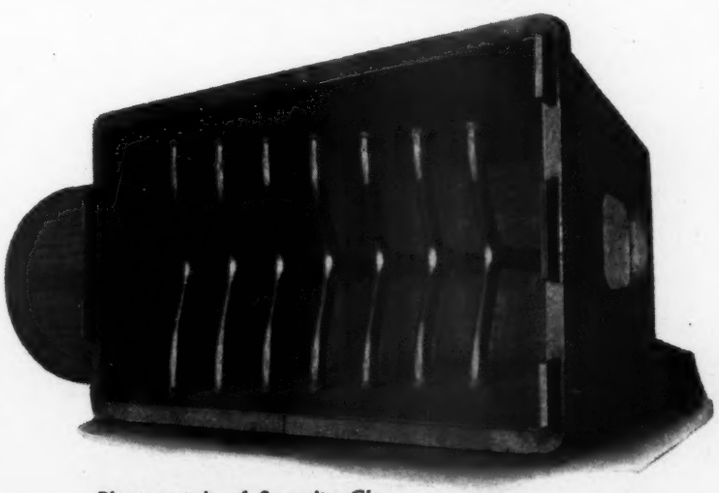


The Security Circulator makes it possible to support a properly proportioned arch in the 198"x96" firebox of the American Railroads' 6-4-4-6 type locomotive. » » » While the Security Circulator was developed by the American Arch Company to keep pace with the demands for an improved brick arch support in large locomotives, it is equally adapted to all types and sizes of fireboxes. » » » In any locomotive firebox, irrespective of size, the Security Circulator will improve combustion and arch efficiency, reduce cinder cutting and flue stoppage, and improve the circulation in the side water legs.



Photograph of Security Circulators assembled in firebox.

COMPANY, INC.

New York *Chicago*

NEWS

Equipment Building Programs

The Chicago, Milwaukee, St. Paul & Pacific has been authorized by the federal district court at Chicago to spend $327,373 for new equipment and to remodel present rolling stock. The C. M. St. P. & P. will spend $223,773 to construct 83, 50-ton all steel box cars and $103,600 to remodel 200 automobile cars in their own shops.

The Chicago, Rock Island & Pacific has undertaken a locomotive improvement program, for which $442,000 will be spent. Included are 20,000-gal. capacity tenders for 21 locomotives, to cost $202,000; and the enlargement of 12 tender tanks to 14,000-gal. at a cost of $26,000. Roller bearings and new engine trucks will be applied to 30 locomotives, at a cost of $147,000.

The Pennsylvania has authorized the construction of 25 21,000-gal. capacity locomotive tenders, to cost approximately $750,000. The tenders will be used in the operation of M-1 type locomotives in through freight service, and will permit the reassignment and redistribution of existing tenders of modern type among locomotives in main line through passenger service. They will supplement an equal number of tenders of similar capacity authorized last year.

Correction—World's Fair Exhibits

In the caption, in "Railroads on Parade" on page 223 of the June issue the New York Central Hudson type locomotive was incorrectly referred to as the "Commodore Vanderbilt." On page 229 the maximum drawbar horsepower of the same type locomotive should be 3,880 at 65 m. p. h. instead of 3,380.

Shop Additions

The Minneapolis, St. Paul & Sault Ste. Marie has awarded a contract amounting to approximately $35,000 to the Ernest M. Ganley Company, Minneapolis, Minn., for the construction of an addition to the machine shop and the rebuilding of a locomotive transfer table at the Shoreham shops of the Soo Line in Minneapolis.

The St. Louis Southwestern has awarded a contract amounting to approximately $35,000, to the Wisconsin Bridge and Iron Company, Chicago, for the construction of extensions to the machine shop and boiler shop at Pine Bluff, Ark.

A. S. M. E. Officers Nominated

Nominees for officers of the American Society of Mechanical Engineers for 1940 were announced at a recent meeting of the nominating committee held at State College, Pa. Nominees presented were: President—W. H. McBryde, consulting engineer, San Francisco, Cal.; vice-presidents—K. H. Condit, executive assistant to president, National Industrial Conference Board, New York; F. Hodgkinson, consulting mechanical engineer, New York; J. C. Hunsaker, head of department of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass.; K. M. Irwin, assistant to vice-president in charge of engineering, Philadelphia Electric Co., Philadelphia, Pa. Managers—J. W. Eshelman, president, Eshelman & Potter, Birmingham, Ala.; L. Helander, head of mechanical engineering department, Kanses State College, Manhattan, Kan.; G. T. Shoemaker, president, United Light & Power Service Co., Chicago.

A. A. R. High-Speed Truck Tests

The board of directors of the Association of American Railroads recently authorized the expenditure of $45,000 for the purpose of making road tests of various types of trucks in modern high-speed freight service. The initial tests were begun June 16 on the Pennsylvania, between Altoona, Pa., and Lock Haven. The test train consists of a Pennsylvania E-6 Atlantic-type steam locomotive with 80-in. driving wheels, and five cars, including two baggage cars and one coach, Nos. 1, 3 and 5, and two test cars, Nos. 2 and 4 in the train. The test cars have been leased, together with their instruments, from the Gould Coupler Corporation, and additional test instruments have been furnished by the A. A. R., and the Pennsylvania. The No. 3 baggage car serves as an office car for the accommodation of the test crew.

The objects of these tests, now being conducted by the A. A. R. Mechanical division, under the direction of W. I. Cantley, mechanical engineer, are to determine whether the conventional freight car truck has satisfactory riding qualities at speeds of 80 m.p.h., or more; also to determine the riding qualities and performance of various trucks designed specifically for the above high-speed service.

At a joint meeting of the various truck manufacturers on January 12, the program of tests was outlined and the following companies agreed to furnish trucks for test purposes, free of charge: Pennsylvania, Gould Coupler Corporation, National Malleable & Steel Castings, American Steel Foundries, Scullin Steel Company, Ohio Steel Foundry Company, Buckeye Steel Castings Company, the Bettendorf Company, Railway Truck Corporation, Standard Car Truck Company and Carry-Mussey Company.

A complete and extensive program of tests has been arranged, which will include road tests of each of these types of trucks under varying speed and load con-

(*Continued on next left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the June Issue

Locomotive Orders

Road	No. of Locos.	Type of Loco.	Builder
Atlantic Coast Line	2	2,000 hp. Diesel-electric[1]	Electro-Motive Corp.
C. R. I. & P.	1	Diesel-electric[2]	American Loco. Co.
Florida East Coast	2	2,000-hp. Diesel-electric[3]	Electro-Motive Corp.
Green Bay & Western	3	2-8-2[4]	American Loco. Co.
Kansas City Southern	1	1,000-hp. Diesel-electric	Electro-Motive Corp.
Phelps Dodge Corp.	1	600-hp. Diesel-electric	Electro-Motive Corp.

Locomotive Inquiries

Boston & Maine	6	600-hp. Diesel-electric	.....

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Aluminum Company of America	10	70-ton covered hopper	Pullman-Std. Car Mfg. Co.
Lehigh & New England	50	70-ton hopper[5]	American Car & Fdry. Co.
Missouri Illinois	125	Box[6]	Mt. Vernon Car Mfg. Co.
	25	50-ton gondola	Mt. Vernon Car Mfg. Co.
Republic Steel Corp.	4	50-ton air dump	Pressed Steel Car Co.
Western Maryland	500	50-ton box	Pressed Steel Car Co.
	500	50-ton hoppers	Bethlehem Steel Co.
	100	50-ton gondolas	Greenville Steel Car Co.
	10	50-ton flat	Greenville Steel Car Co.

Freight-Car Inquiries

Dow Chemical Co.	10	8,000-gal. tank	.....
Erie	6	16,000-gal. aux. water tank	.....
Tennessee Valley Authority	30	40-ton hopper	.....

Passenger Car Orders

Road	No. of Cars	Type of Car	Builder
Atlantic Coast Line	14	See Note[1]	Edw. G. Budd Mfg. Co.
Florida East Coast	14	See Note[3]	Edw. G. Budd Mfg. Co.

Passenger Car Inquiries

Seaboard Air Line	..	See Note[7]	.....

[1]The A. C. L. has ordered from the Edw. G. Budd Mfg. Co. two light weight trains of seven cars each to be hauled by the two Diesel-electric locomotives ordered from the Electro-Motive Corp. The trains will be operated between New York and Miami, Fla.

[2]This locomotive and the two ordered from the Electro-Motive Corporation as reported in the April issue, will be used on the Denver and other Rockets.

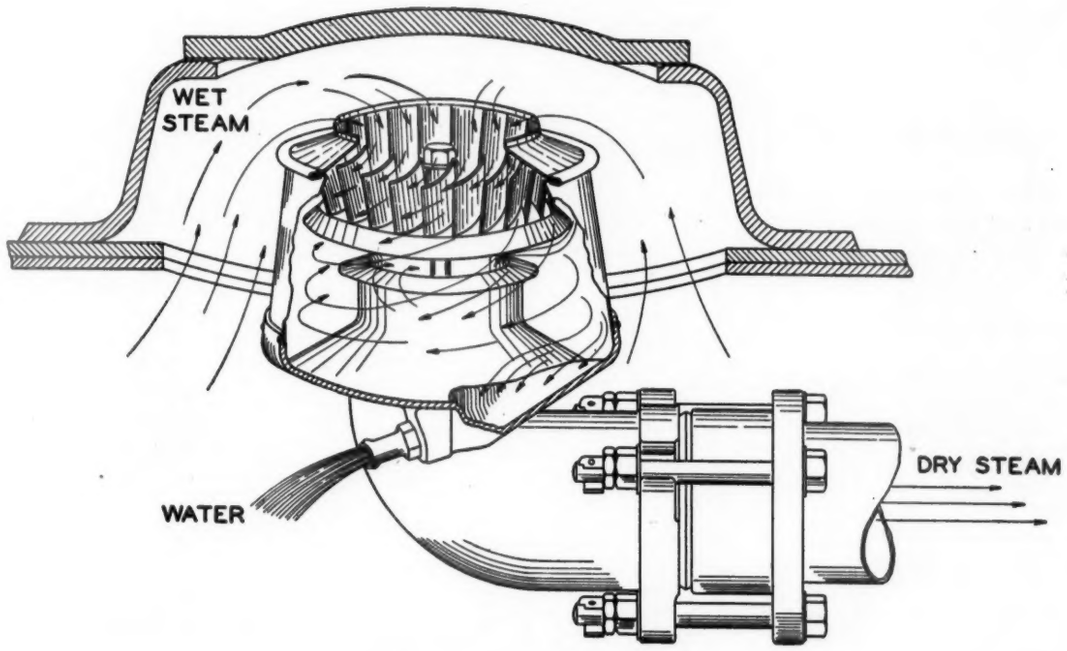
[3]The Florida East Coast, reported in the June issue, as planning to buy two new streamline trains of seven cars each, has ordered 14 lightweight, stainless steel cars for these trains from the Edward G. Budd Manufacturing Company. These trains, which will be hauled by the 2,000-hp. locomotives ordered from the Electro-Motive Corporation, will consist of a combination baggage and chair car, four chair cars, one dining car and one observation lounge car. They will be placed in service about December 1, between Jacksonville, Fla., and Miami.

[4]These locomotives will have 22-in. by 30-in. cylinders, 64-in. driving wheels, 245-lb. boiler pressure and a total weight of 285,000 lb. in working order.

[5]Special type, hatchway-roof, hopper-bottom steel cars to be used for bulk cement lading.

[6]These in addition to the 150 cars for this road reported in the Missouri Pacific order in the May issue.

[7]Inquiring for one or two lightweight coach trains of seven cars each.



TESTS

of an Elesco Tangential Steam Dryer

The Elesco tangential steam dryer has been tested on modern locomotives and its ability to handle large quantities of moisture was conclusively demonstrated by spraying water into the dryer, in quantities up to 20 per cent of the water evaporated by the boiler. Water sprayed into the dome was accurately measured with a flowmeter and the drop of superheat was read on the pyrometer.

The results obtained are shown in the accompanying table. Attention is called to test run No. 2, when 6756 lb. of water were sprayed into the dome, equivalent to 16.4 per cent moisture, and resulting in only a 36 degree drop in superheat. Had it not been for the dryer, there would have been a 244 degree drop in superheat.

Run Number	Steam Flow Thru Dry Pipe	Water Sprayed into Dryer		Actual Drop in Superheat °F	Calculated Drop in Superheat if Sprayed Water Had Not Been Separated °F	Moisture in Dry Pipe		Moisture Returned to Boiler Lb./Hr.	Dryer Efficiency Per Cent
	Lb./Hr.	Lb./Hr.	Per Cent			Per Cent	Lb./Hr.		
1	2	3	4	5	6	7	8	9	10
1	34562	1999	5.5	11	87	0.6	212	1787	89.5
2	35073	6756	16.4	36	244	2.1	723	6033	89.1

ditions, also with round—and eccentric-ground car wheels. The test procedure has been worked out in great detail so as to develop accurate comparative data on a strictly impartial basis, with minimum delay and cost in changing trucks, varying car loads, etc. It is anticipated that the tests will be completed late this Fall.

"Royal Train" Locomotives Now at N. Y. World's Fair

THE Canadian locomotives — Canadian National No. 6400 and Canadian Pacific No. 2850—which hauled the royal train during the recent visit of King George and Queen Elizabeth in the Dominion, are now on exhibit at the railroad area at the New York World's Fair.

C. N. R. No. 6400, which is said to be the largest locomotive in the British Empire, is 94 ft. long with tender and weighs in excess of 650,000 lb. It left Montreal, Que., on June 16 and traveled under its own steam over the Central Vermont to Springfield, Mass., where, owing to weight limitations and clearance conditions, its tender was emptied of water and coal and the locomotive deadheaded the remainder of the distance to the fair.

C. P. R. No. 2850 was one of 20 of the same series constructed in 1929 and 1930. For the purpose of hauling the royal train it was redecorated with a semi-streamline front bearing the royal arms over the headlight. After a check-up at the Angus shops, the 2850 hauled its regular train to Toronto, Ont. From there it ran light over the Toronto, Hamilton & Buffalo to Welland, Ont., Michigan Central to Suspension Bridge, N. Y., New York Central main line to Rochester, N. Y., West Shore and Boston & Albany to Chatham, N. Y., Harlem division of the New York Central to New York, New York, New Haven & Hartford over Hell Gate bridge and Long Island to the fair grounds. Both locomotives which are finished in royal blue and silver, will appear in the final scenes of the opera-pageant "Railroads on Parade."

Chilled Car Wheel Association's Work Commended

THE American Trade Association Executives have this year sponsored their seventh annual competition for outstanding trade association activities. Over 20 associations competed, submitting individual manuscripts and supporting documents covering both general activities and special achievements. The only association to receive recognition for work of specific interest and value in the steam railroad field was the Association of Manufacturers of Chilled Car Wheels, which received one of eight honorable mention prizes.

The prizes were presented on behalf of the American Trade Association Executives, by Edward J. Noble, executive assistant to the United States secretary of commerce, at a meeting in Washington, D. C., last month, and, in the absence of President Frank Hardin of the Association of Manufacturers of Chilled Car Wheels, Past President D. H. Sherwood, vice-president, Maryland Car Wheel Company, Baltimore, Md., accepted the award.

The citation read as follows: "The Association of Manufacturers of Chilled Car Wheels—for its achievement in obtaining complete co-operation of its industry in a program of quality standardization. This was brought about through an effective industrial research program, followed by arrangements for a field staff of technical inspectors which periodically visits all railroad car-wheel factories, the receipt of daily reports on processes and specifications and special training for employees. The quality of product has been improved. Production expenses have lessened. Greater appreciation of mutual engineering and selling problems has been a natural and desirable result."

D. L. & W. Buffet-Lounge Car

THE Delaware, Lackawanna & Western has turned out a buffet-lounge car in its Kingsland (N. J.) shops, the interior decoration of which utilizes, for the first time in railroading, color photography on stainless steel. A new secret process whereby the subject is photographed directly on stainless steel by chemical-light action has been developed by Permanent Arts, Inc., New York, and the Electro-Metallurgical Company, a subsidiary of United States Steel Corporation. For the Lackawanna car six photographs of early locomotives of the road ("Spitfire," "Essex," "Speedwell," "No. 16," "John R. Blair," and the "A. Lincoln") have been so reproduced and the steel plates imbedded in plate glass mirrors, left partially unsilvered to permit the photographs to be viewed. These mirrors appear in panels at the ends of the buffet-lounge section.

The car is fully air-conditioned by a Safety-Carrier ice-activated system with evaporator unit and Pyle-National multivent outlets. The kitchen is air-conditioned partly by a branch outlet and partly by exhaust air from the main part of the car. Interior illumination of the car, of 10 foot candle intensity, consists of a skylight type center row of 90 15-watt lamps with a white plastic cover; safety, double-prismatic direct reading lights over each seat with 25-watt lamps and four small table lamps.

The car is a rebuilt standard steel parlor car designed by Douglas Ernst of Contract Service, Inc., New York.

Supply Trade Notes

THE BIRD-ARCHER COMPANY has moved its Chicago office from 122 South Michigan avenue to 2030 North Natchez avenue.

◆

G. FRED DRIEMEYER, sales engineer for the General Steel Castings Corporation, has been promoted to assistant works manager at Granite City, Ill.

◆

WILLIAM H. HARMAN and William H. Winterrowd, vice-presidents in charge of sales and operations, respectively, of the Baldwin Locomotive Works, have been elected to the board of directors of the company.

◆

THE AMERICAN ENGINEERING COMPANY, Philadelphia, Pa., has purchased the Diamond Machine Company, Providence, R. I., and will continue the manufacture of the Diamond face grinder in its Philadelphia plants.

JOSEPH T. RYERSON & SON, INC., Chicago, has purchased the Philadelphia plant of the Taylor-Wharton Iron & Steel Company, which Ryerson has been operating under lease.

◆

PARKER F. WILSON has been appointed president of the Pittsburgh Steel Foundry Corporation, Glassport, Pa., and G. A. Hassel, the company's former president, will continue as chairman of the board of directors.

◆

J. G. COUTANT has been appointed vice-president of Controlled Steam Generators, Inc., New York, in charge of engineering work in connection with the design and construction of steam generators and metallic heat recuperators with controlled-pressure circulations.

◆

THE CARBOLOY COMPANY, INC., has opened a new plant and general offices at Detroit, Mich., this new plant for the manufacture of cemented carbide products, embraces a total area of 121,750 sq. ft. and combines all manufacturing facilities formerly divided among Carboloy plants in Cleveland, Ohio, Detroit, and Stamford, Conn.

◆

L. C. RICKETTS, recently appointed general superintendent of the Harrison, N. J., works of the Worthington Pump & Machinery Corporation, has been appointed manager of that works. W. D. Sizer has been appointed executive engineer in charge of all engineering activities at Harrison, and B. R. McBath, has been appointed engineer in charge of the centrifugal engineering division, succeeding Mr. Sizer.

◆

J. FREDERIC WIESE who has been appointed general manager of sales of the Lukens Steel Company, Coatesville, Pa., was born at Parkesburg, Pa., in January, 1899, and educated in the Parkesburg

schools and Swarthmore College, from which he was graduated in 1921, with the degree of bachelor of arts. Mr. Wiese then joined the Chicago sales office of the Parkesburg Iron Company and was en-

J. Frederic Wiese

gaged in the sale of boiler tubes to the railroads until the latter part of 1924, at which time he was transferred to the home office. The following year he became associated with the Lukens Steel Company, where he has served continuously in its flanging, railroad and general sales departments, with the exception of a period of one year in 1928. In 1935, he was appointed assistant to vice-president in charge of sales, which position he held at the time of his recent promotion to general manager of sales.

◆

ALBERT C. PICKETT of the Gustin-Bacon Manufacturing Company, Kansas City, Mo., has been transferred to Chicago as manager of the Insulation division, Chicago district. Mr. Pickett was born at Waco, Texas, on October 5, 1897, and completed high school and business college courses at that place. He served on the Missouri-Kansas-Texas and the Texas & Pacific in stenographic and clerical capacities in the mechanical stores, engineering and transportation departments, with the exception of a period during the World War when he was with the field artillery, United States Army, until 1922, when he became associated with the railroad department of the Johns-Manville Company, at St. Louis, Mo. In 1925 he was transferred to Houston, Texas, as sales engineer, where he was located until 1929, when he was promoted to assistant sales manager, transportation department, southwestern division, with headquarters at St. Louis. In 1933, he was appointed sales

Albert C. Pickett

manager, in which capacity he served until his resignation on May 1 to enter the service of the Gustin-Bacon Manufacturing Company.

Personal Mention

General

EDWARD E. ROOT, whose appointment as assistant chief of motive power of the Delaware, Lackawanna & Western at Scranton, Pa., was announced in the June issue, was born at Altoona, Pa., and edu-

Edward E. Root

cated in the public and high schools of that city. He entered railroad service in September, 1902, as a machinist apprentice in the Altoona works of the Pennsylvania, following which he completed the four-years' course of mechanical instruction, road, operation and testing of equipment. In December, 1906, Mr. Root was assigned to special duty in the mechanical, maintenance and operating departments. He was appointed motive-power inspector in December, 1907, on the staffs of the master mechanic and superintendent of motive power. In December, 1908, Mr. Root became enginehouse foreman of the Monongahela division and general foreman of engine operations at Monongahela City, Pa. In September, 1913, he was appointed master mechanic and superintendent of motive power of the Monongahela at Brownsville, Pa. Mr. Root resigned in April, 1920, to engage in business at Pittsburgh, Pa. In December, 1923, he reentered railroad service with the Delaware, Lackawanna & Western on the Morris and Essex division of which he was serving as master mechanic, with headquarters at Hoboken, N. J., at the time of his recent appointment.

H. C. WYATT has been appointed superintendent of the Shenandoah division of the Norfolk & Western at Roanoke, Va., as announced in the June issue of the *Railway Mechanical Engineer*. After working for the Norfolk & Western during school vacation periods, Mr. Wyatt was appointed special apprentice in the Roanoke shops in June, 1924. Since that time he served successively as shop inspector at Roanoke and Bluefield, W. Va.; special apprentice at Portsmouth, Ohio; assistant foreman and foreman at Iaeger, W. Va.; assistant road foreman of engines, Pocahontas division, and general foreman at Columbus, Ohio. He was appointed assistant master mechanic of the Radford-Shenandoah divisions on August 1, 1937, the position he held until his appointment as division superintendent.

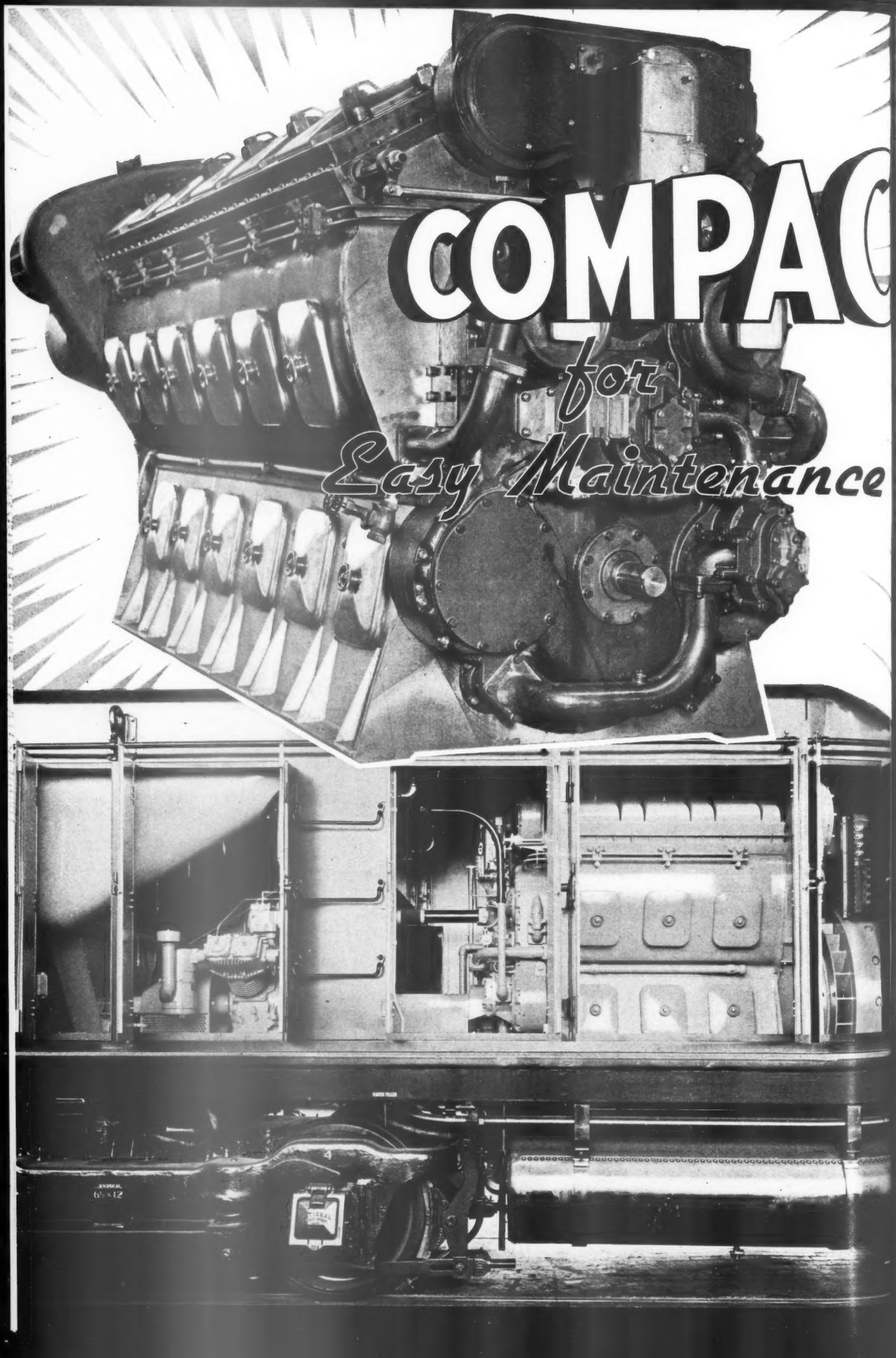
H. C. Wyatt

OTTO JABELMANN, assistant to the president in charge of research, of the Union Pacific, at Omaha, Neb., has been elected

Otto Jabelmann

to fill the newly-created position of vice-president in charge of research and mechanical standards, with the same headquarters. Mr. Jabelmann was born at Cheyenne, Wyo., on July 24, 1890, and entered railway service as a call boy for the

(*Continued on second left-hand page*)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Union Pacific on September 22, 1906. He has been continuously in the service of the Union Pacific since that time with the exception of three years, during which time he attended the University of Michigan and a period from May to August, 1917, when he was employed as a machinist on the Southern Pacific at San Francisco, Calif. Mr. Jabelmann advanced through the mechanical department, serving successively as apprentice, machinist helper, machinist and assistant enginehouse foreman at Cheyenne, general foreman at Laramie, Wyo., machinist at North Platte, Neb., and enginehouse foreman, district foreman, and superintendent of shops at Cheyenne. On January 1, 1929, he was transferred to Omaha as superintendent of shops; in October, 1933, was appointed general superintendent of motive power and machinery at Omaha, and in November, 1937, became assistant to the president in charge of research. Mr. Jabelmann has been in charge of the designing of the new steam-electric locomotive recently delivered to the Union Pacific; the new Diesel-electric locomotives on the City of Los Angeles, the City of San Francisco, and the City of Denver; the new truck improvements used on lightweight freight cars, and new lighting and air-conditioning equipment.

JOHN GOGERTY, general superintendent of motive power and machinery of the Union Pacific at Pocatello, Idaho, has been transferred to the Eastern district, with headquarters at Omaha, Neb.

O. G. PIERSON, master mechanic of the Atchison, Topeka & Santa Fe at Arkansas City, Kan., has been appointed mechanical superintendent, with headquarters at Fort Madison, Iowa, succeeding J. P. Morris.

LOGAN A. HAMILTON, locomotive engineer of the Union Pacific, has been appointed acting fuel engineer of the Eastern district, with headquarters at Omaha, Neb., succeeding O. K. Woods, who has been given a leave of absence.

J. P. MORRIS, mechanical superintendent of the Atchison, Topeka & Santa Fe, with headquarters at Fort Madison, Iowa, has been promoted to general assistant mechanical department, with headquarters at Chicago.

S. C. SMITH, master mechanic of the Union Pacific at Pocatello, Idaho, has been appointed assistant general superintendent of motive power and machinery of the Western districts, with the same headquarters.

W. R. HARRISON, superintendent of shops of the Atchison, Topeka & Santa Fe at Albuquerque, N. M., has become mechanical superintendent, at Amarillo, Tex. Mr. Harrison began railway service as a machinist apprentice on the Southern at Princeton, Ind., and on April 1, 1912, he joined the Santa Fe as a machinist at Richmond, Cal., and was transferred to Topeka, Kan., a short time later. In November, 1912, he was promoted to night enginehouse foreman at Argentine, Kan., and in 1914, was advanced to general foreman at Newton, Kan. Mr. Harrison was promoted to master mechanic at Chanute, Kan., in November, 1917, and served as master mechanic or acting master mechanic at Argentine and Chanute until February 1, 1934. On the latter date he became superintendent of shops at Albuquerque, the position he held until his recent promotion to mechanical superintendent.

E. E. MACHOVEC, mechanical superintendent of the Atchison, Topeka & Santa Fe at Amarillo, Tex., retired on June 1. Mr. Machovec was born on March 26, 1866, and entered railway service in 1885, as a machinist apprentice on the Chicago, St. Paul, Minneapolis & Omaha. In 1904, he entered the service of the Denver & Rio Grande Western at Helper, Utah, and the following year he became associated with the Santa Fe as enginehouse foreman at Newton, Kan. In 1908, he became general foreman at that point and in the fall of that year was advanced to master mechanic at Newton. Mr. Machovec was transferred to Argentine, Kan., in 1911, and from November, 1921, to March, 1922, served as acting mechanical superintendent of the Northern district, Western lines, with headquarters at La Junta, Colo. In September, 1922, he was appointed mechanical superintendent of the Southern district, with headquarters at Amarillo.

Master Mechanics and Road Foremen

FREDERICK T. JAMES, who has been appointed to the position of division master mechanic of the Delaware, Lackawanna & Western at Hoboken, N. J., as noted in the June issue, was born at Buffalo, N. Y., on March 16, 1894. He worked at various

F. T. James

occupations while attending grammar school and the first year of high school, and became a machinist apprentice at Farrar & Trafts Machine & Boiler Works, Buffalo, in July, 1908. His later educational training has included courses in civil service and government at Bryant & Stratton Business College, Buffalo and machineshop practices and automobile mechanics at the Buffalo Y. M. C. A. He has acted as chairman of foremanship courses at Hoboken, N. J., under the New Jersey State Vocational Education Department, and has taken lectures and discussions in shop employee psychology at the State Normal School at Montclair, N. J. He also took a special electrical course at the Paterson, N. J., Vocational School prior to the electrification of the metropolitan section of the Lackawanna. In September, 1909, he became an enginehouse utility worker at East Buffalo, on the Lackawanna. For some months in 1911, he was assigned to the master mechanic's office in connection with the compilation of special locomotive performance reports, later being promoted to coal chute foreman at East Buffalo enginehouse, and then acting as a machinist at the East Buffalo locomotive shop. He became general foreman at Groveland, N. Y., in October, 1915, and erecting shop foreman at East Buffalo in February, 1918. He then filled various positions until in February, 1923, he was assigned to the Buffalo division as special locomotive and boiler inspector. On November 1, 1923, he was transferred to Binghamton as day enginehouse foreman, and on February 18, 1924, was promoted to general foreman at the Kingsland, N. J., locomotive shop. Mr. James was secretary of the Lackawanna Foremen's Association at East Buffalo from 1918 to 1922, and was First Lieutenant, Engineers, 491st Division, Reserve Officers, from 1925 to 1935. He then served as a member of the sub-committee on Consolidation of Major Shops, Regional Coordinating Committee, Eastern Railway Group. He was elected president of the International Railway General Foremen's Association in September, 1936, and secretary-treasurer of the same association in September, 1937.

R. E. WEES, superintendent of shops of the Union Pacific at Cheyenne, Wyo., has been appointed master mechanic at Pocatello, Idaho, replacing S. C. Smith.

R. B. MILLER has been appointed master mechanic, Kamloops division, British Columbia district, of the Canadian National, with headquarters at Jasper, Alta.

P. J. DANNEBERG, master mechanic of the Atchison, Topeka & Santa Fe at Slaton, N. M., has been transferred to Clovis, N. M., succeeding G. R. Miller.

L. E. FLETCHER, master mechanic of the Atchison, Topeka & Santa Fe at La Junta, Colo., has been transferred to Slaton, N. M., succeeding P. J. Danneberg.

JAMES W. ATKINSON, general locomotive foreman of the Atchison, Topeka & Santa Fe at Argentine, Kan., has become master mechanic at Arkansas City, Kan.

G. C. HESS, assistant road foreman of engines of the Maryland division of the Pennsylvania, has been appointed acting road foreman of engines of the New York division.

RAY E. MURPHY has been appointed road foreman of engines of the Yellowstone division of the Northern Pacific with headquarters at Dickinson, N. D.

PATRICK W. HANNON, road foreman of engines of the Northern Pacific at Dickinson, N. D., has been appointed road foreman of engines at Auburn, Wash.

(*Turn to next left-hand page*)

Car Department

A. C. SCHROEDER, general foreman of the freight shop of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., has been promoted to the position of general car department supervisor at Minneapolis, Minn.

F. J. SWANSON, general car department supervisor of the Chicago, Milwaukee, St. Paul & Pacific at Minneapolis, Minn., has been appointed general foreman in the freight department of the Milwaukee shops at Milwaukee, Wis.

Shop and Enginehouse

G. R. MILLER, master mechanic of the Atchison, Topeka & Santa Fe, at Clovis, N. M., has been appointed superintendent of shops at Albuquerque, N. M., succeeding W. R. Harrison.

C. F. SPICKA, who has been acting assistant general superintendent of motive power and machinery of the Eastern district of the Union Pacific at Omaha, Neb., has returned to his former position as superintendent of shops at Cheyenne, Wyo.

Obituary

E. A. SCHRANK, master mechanic of the Chicago, Burlington & Quincy, with headquarters at Casper, Wyo., died on June 22 following an operation.

CALVIN C. HIPKINS, road foreman of engines of the New York zone of the Pennsylvania with headquarters at Jersey City, N. J., died on June 12 at his home in Union, N. J., following a heart attack. He was 57 years old.

BURT J. FARR, general superintendent of motive power and car equipment of the Grand Trunk Western, at Battle Creek, Mich, died on June 10, after an extended illness. Mr. Farr was born at Ellenburg, N. Y., on September 18, 1876, and entered railway service in 1893 as a machinist apprentice on the Central Vermont. In 1898, he was promoted to machinist and two years later was advanced to the position of general foreman. In 1907, he went with the Northern Railway of Costa Rica as master mechanic and in 1910, he became

Burt J. Farr

associated with the Panama Railroad, serving in the engineering department. On January 1, 1915, after his return to this country, Mr. Farr was appointed general foreman on the Grand Trunk Western at Nichols, Mich., and a few months later became locomotive foreman. He was appointed master mechanic on October 1, 1916, and two years later became superintendent of motive power and car building at Detroit, Mich. On January 1, 1928, he was appointed general superintendent of motive power and car equipment at Battle Creek.

JAMES W. KING, vice-president of the Association of American Railroads in charge of its Operations and Maintenance Department, was found dead on June 12 along the Richmond, Fredericksburg & Potomac tracks about 20 miles north of Richmond, Va. According to information received at the A. A. R., he became weak from illness, and fell off the rear platform of the train on which he was traveling to his home in Richmond. Mr. King, who joined the A. A. R. last January as successor to J. M. Symes, was born on February 13, 1890, in Sussex County, Va. After completing school in Sussex County, he attended Smithfield Business College, Richmond. He served in various clerical and secretarial positions on the Chesapeake & Ohio and the Atlantic Coast Line, later rising successively to chief special agent and freight-claim agent for the former road. He served as a member of the Executive Committee, Freight Claim

James W. King

division, American Railway Association; as chairman of an Arbitration Committee, and was chairman of the Chicago, Virginia and Southeastern Claim Conferences, respectively. Mr. King, until his election to the Association of American Railroads last January, was general superintendent of transportation of the Chesapeake & Ohio, to which position he succeeded on April 18, 1933. In 1934 Mr. King was appointed by the Co-ordinator of Transportation to membership on the Committee on Freight Car Pooling.

Trade Publications

EYESHIELDS.—The Jackson Electrode Holder Co., 15122 Mack avenue, Detroit, Mich. Folder on eyeshields for general eye protection in hazardous occupations.

◆

JACKS.—The Buda Company, Harvey, Ill. Eight-page bulletin. Illustrates and describes Buda line of jacks for railroad service.

◆

FERROUS CASTINGS.—Belle City Malleable Iron Co. and Racine Steel Castings Co., Racine, Wis. Four-page bulletin descriptive of four types of ferrous castings—steel, malleable, pearlitic malleable, and electric gray iron.

◆

TAPER DIE HEADS.—The Geometric Tool Company, New Haven, Conn. Bulletin CT-1, Geometric Style CT taper die heads for use in hand screw machines, turrent lathes, and other similar equipment.

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

◆

EYE PROTECTION.—Mine Safety Appliances Company, Braddock, Thomas and Meade streets, Pittsburgh, Pa. Eight-page bulletin No. CE-8, illustrating goggles and spectacles, welding helments and shields, etc.

◆

BOILER SHOP MACHINERY.—Jos. T. Ryerson & Son, Inc., Lock Box 8000-A, Chicago. Portfolio of information on Ryerson flue shop equipment, together with floor plans and a detailed explanation of the method of handling tube repairs in the boiler shop.

"INDUSTRIAL HEAD AND EYE PROTECTION."—Chicago Eye Shield Company, 2300 Warren Boulevard, Chicago. 48-page illustrated book on goggles, respirators, spectacles, masks, welding helmets and other safety devices.

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DIE HEADS.—Landis Machine Company, Inc., Waynesboro, Pa. Bulletin No. 5-90. Landmatic, Lanco, and Landex heat-treated die heads for turret lathes, bolt-threading machines, and automatic screw machines, respectively.

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BEARING BRONZE.—Johnson Bronze Company, New Castle, Pa. Catalogue 390; 72 pages. Progressive size listings of Johnson general purpose bearings in 800 stock sizes, machine finished ready for assembly. Special sections on oil grooving, flanged bearings and bushings, and a decimal equivalent chart.